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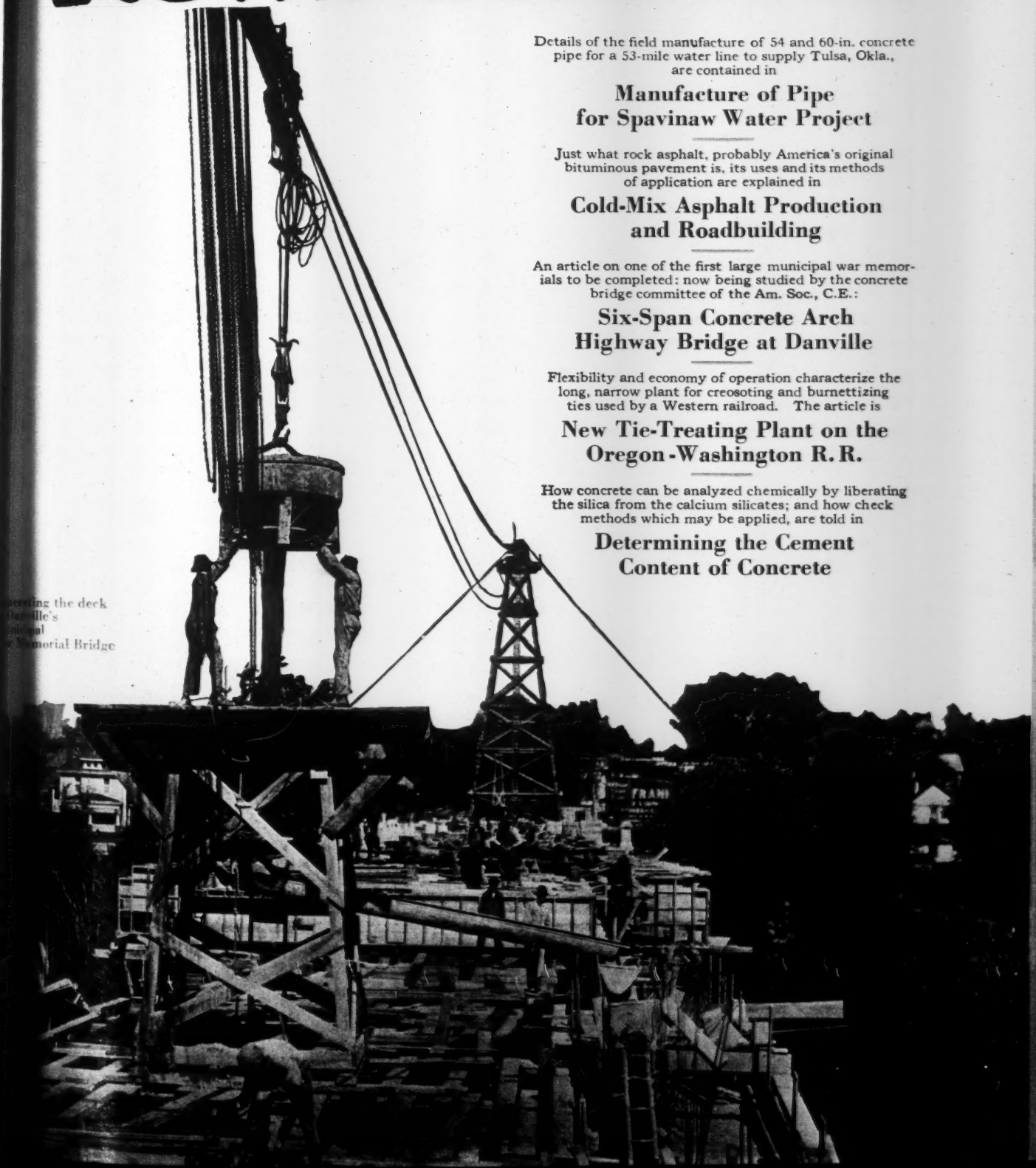
MAY 26 1924

May 22, 1924

Engineering News-Record



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...Memorial Bridge

Details of the field manufacture of 54 and 60-in. concrete pipe for a 53-mile water line to supply Tulsa, Okla., are contained in

Manufacture of Pipe for Spavinaw Water Project

Just what rock asphalt, probably America's original bituminous pavement is, its uses and its methods of application are explained in

Cold-Mix Asphalt Production and Roadbuilding

An article on one of the first large municipal war memorials to be completed: now being studied by the concrete bridge committee of the Am. Soc., C.E.:

Six-Span Concrete Arch Highway Bridge at Danville

Flexibility and economy of operation characterize the long, narrow plant for creosoting and burnettizing ties used by a Western railroad. The article is

New Tie-Treating Plant on the Oregon-Washington R.R.

How concrete can be analyzed chemically by liberating the silica from the calcium silicates; and how check methods which may be applied, are told in

Determining the Cement Content of Concrete

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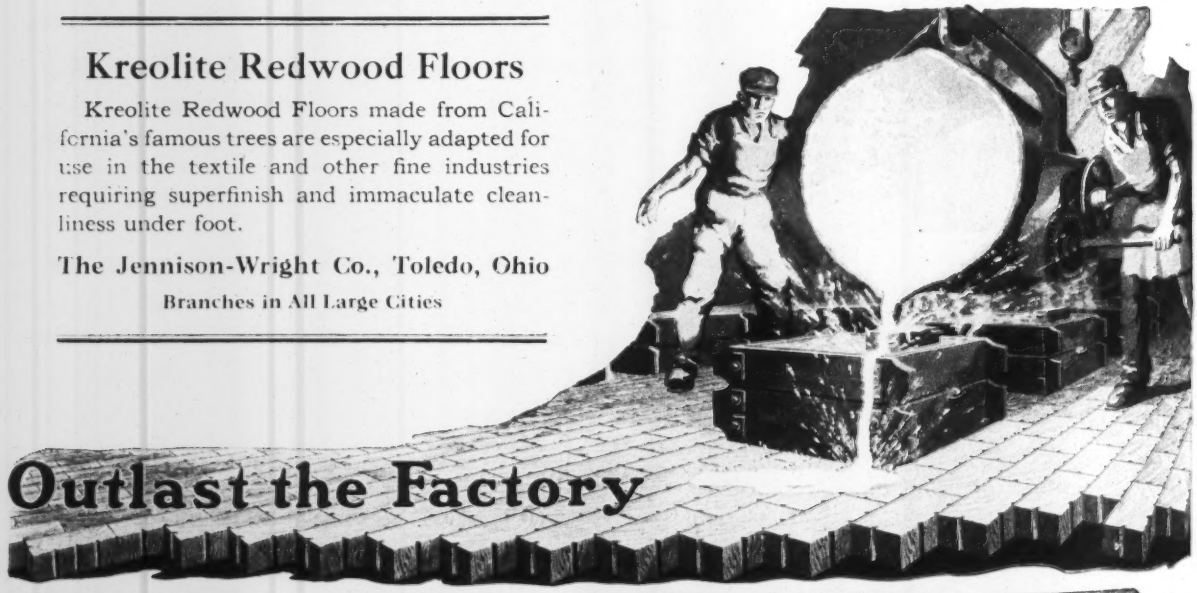

Outlast the Factory

WOOD BLOCK FLOORS

A Consolidation of Engineering News, Engineering Record and The Contractor

ENGINEERING NEWS-RECORD

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DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

FRANK C. WIGHT
Editor

Volume 92 NEW YORK, MAY 22, 1924 Number 21

The "Gold Brick" Bonus

CONGRESS evidently thinks that the people want a soldier bonus; no one else seems to think so but Congress makes the laws. The country is therefore saddled with a tremendous burden for the next twenty years and no one is benefited, not even the veteran who individually gets only some driblets of money or an insurance policy which he could buy for from $10 to $40 a year. We will now have to sit back and see what the combined massive intellect of our elected representatives can produce in the way of providing funds to pay this "gold brick" bonus. All hope for a sensible tax revision scheme is gone for the present.

More Hope for the Dawes Plan

ELECTIONS more often register dissatisfaction with existing conditions than they endorse the policies or the politics of the new administration. Certainly this seems to be the case in Europe today. In England, last fall, and in France and Germany this month, the voter has been more anxious to get the old crowd out than to get the new crowd in. But in France this state of mind is hopeful, because it indicates that the Poincaré elevation of emotion over economics is not accepted by the French people. The liberals, or the socialists, or whatever one chooses to call the new party in power, are more disposed to talk business with England and with Germany and to follow the lead of the Dawes report, which is a business and not an emotional report. Poincaré, in his letter to Premier Macdonald, now claims that he, too, was willing and anxious to get down to an economic basis in discussing reparations and the Rhine occupation, but this reform is a little late. His successor will profit by his example of failure.

Motor Traffic in Tunnels

A CLEARER view of the problem of operating motor-vehicle traffic through long tunnels is given by recent experiences in the Liberty tunnels at Pittsburgh. Hitherto two opposing views have been held with respect to motor-traffic tunnels, one group of people holding that traffic through a tunnel is not essentially different from street traffic in its difficulties and dangers, the other holding that the danger of carbon monoxide poisoning is so extreme as to make long tunnels impracticable for regular use with heavy motor traffic. The Liberty tunnel experience indicates that neither view is correct. The twin tunnels in Pittsburgh, something over a mile long between portals, have been operated for six months without ventilation, and have proved themselves entirely practicable for operation. Carbon monoxide production is not so serious a matter as some have believed, and natural ventilation appears to be capable of disposing of the gases satisfactorily under moderate traffic. But on the other hand, as happened a week ago, conditions may become serious at any moment, and chance traffic interruption, heavy gas evolution and resulting panic may produce a critical condition with the gravest results. On the basis of the present experiences, then, it may be concluded that long tunnels can carry heavy motor traffic quite successfully, but only under constantly maintained artificial ventilation and with unflagging supervision to assure smooth movement of traffic. Rigid policing promises to be much more important in tunnel operation than in handling the traffic of even the most congested surface streets.

Bridge Fire Protection

A SMALL fire in the timber decking of the Williamsburg bridge in New York brings a fresh reminder of the risk inherent in wood bridge floors as ordinarily constructed and maintained. Heavy traffic, with the attendant oil and grease accumulation and an occasional lighted match, multiplies the fire risk, which under other conditions is of negligible proportions. In an inquiry made two years ago in the course of a study of the need for bridge fire-protection, it was learned that on many wood-floor bridges on heavily traveled highways there is a fire nearly every day during the summer months. Experience shows that the danger is small where the floor is sound and well maintained, but increases rapidly as the woodwork becomes splintered, develops open cracks, and collects combustible trash. While fires are ordinarily extinguished without much difficulty, alarm and panic must be reckoned among the resulting losses, in addition to the traffic interruption and other direct loss. Fire protection of wood floors is therefore an objective well worth special effort and expenditure. However, it is largely an unsolved problem, and much further work needs to be done in dealing with it. The study above mentioned was a pioneer inquiry, and some of the results are represented in the fact that fire stops and similar expedients to prevent or limit fires are occasionally included in bridge plans today. But there is opportunity for much additional study and much practical trial of protective expedients and devices. Both fire prevention and fire fighting claim the engineer's attention as essential elements in wood-floor bridge design.

Pledging Road Income

ANTICIPATION of income is a common practice in contracting road work. Seldom in any program of highway improvement are all the funds in hand when contracts are signed to satisfy the obligations of the contract. The money is merely in sight. It is known that income accruing from taxes and other sources will exceed the payments required as completed portions of the highways are turned over to the public. Assuming obligations which anticipate income in this way is sound business and good public policy. The only question which arises is, How far ahead is it wise to pledge future highway income? Generally it has been the practice not to exceed the period of the immediate construction season or, if contracts are awarded in the late

fall, not to exceed the period of the coming construction season. It appears, however, that there may be a legal restriction of privilege at this point. If the pledge period is extended beyond the annual or biennial period covered by the tax and appropriation acts of the preceding legislative assembly then the contract may be invalid. This is the point of the decision outlined in our news section by which the Kentucky Court of Appeals has abrogated contracts let last December for road construction amounting to nearly three million dollars. The terms and scope of the court action are so fully stated in the news item that they need not be amplified here. They should, however, be read by highway officials. Apparently the decision lays down a fundamental principle of the constitutional rights of legislatures which has to be kept well in mind when pledging future income for highway improvement.

Practical Science

ENGINEERS may take heed of the speech the President made at the dedication of the new home of the National Academy of Science at Washington on April 28. It was made to and about the followers of pure science but the moral he drew has peculiar application to engineers. Science said Mr. Coolidge, is the careful assembling of facts, their comparison and interpretation. The disposition to follow the truth is the distinguishing feature of the scientist. But what the nation needs is that same scientific devotion to truth and the same logical deduction from it applied to "everything that touches our life as a nation." The President did not pursue the thought further but he might well have pointed out that the engineer has the opportunity to extend this scientific method to the larger problems of the day. For the engineer is a practical scientist. His training and his methods are those of the delver after nature's secrets but his medium is the workaday world. He has to deal with material, which is all the pure scientist deals with, but he has also to deal with money and men which the scientist does not like to bother with. If then, the pursuit of truth, which Mr. Coolidge commends, is to be carried into our mutual relations, into the conduct of government and the conduct of business, who better is fitted to undertake it than the man who, added to his fundamental worship of things as they are, has the advantage of knowing what men do with those things and how they are going to be paid for.

A Restriction Removed

LAST fall we called attention to a curious wording in the law of the State of New York governing free state scholarships which forbade the winner of such scholarships from pursuing an engineering course in college. The legislature that has just adjourned revised the law and the governor has just approved the revision, so that now there is to be no discrimination against the engineering student. The earlier law seemed to be based on a theory that state licensing in itself conferred such benefits on the engineering profession that the state should not further aid the embryo practitioner. The state's educational directors—and through them the legislators—have been convinced that this view of licensing as a benefactory function is not legitimate, and the youth who in fair competition is able to win a scholarship is no longer to be barred from attempting to become an engineer.

Confusing the Issue

AFTER the way in which the case for the railroads was presented at the reopened hearing on automatic train-control before the Interstate Commerce Commission they will deserve little sympathy if the commission fails to modify or withdraw its second order which practically doubled the mileage of track to be equipped with train-control devices. The case against this second train-control order is a good one and can stand alone. Automatic train-control is still in the experimental stage and the original order requiring the equipment of one division on each of the principal railroads was generally accepted as just as well as necessary. But no such justification can be found for the second order. It requires only duplication, and duplication before the first installations can be studied and improved upon will only duplicate the expense without a commensurate advance in the development of automatic train-control. In fact on many roads the original installation is bound to be scrapped in favor of some other device which is found to be superior, or in the interest of interchangeability. These are clear arguments—almost statements of fact—on which the railroads could have based a good case. Instead they saw fit to becloud the issue by arguments to the effect that the money required for train-control could be used to better advantage for grade crossing elimination, and by testimony concerning the supposed dangers of automatic train-control from witnesses who, by their absurd statements, showed their complete ignorance of the present status of train-control. Probably the introduction of such testimony, some of which was little short of an insult to the intelligence of the commissioners, will but impress them with the fact that the railroads feel they have a poor case and so cause them to continue the second order in force.

Federal Authority Over Rivers

IT IS a satisfaction to learn from recent events at Pittsburgh that the long contest between the federal government and the local authorities over the Allegheny River bridges has at last been ended, and thereby a bad situation cleared up. Allegheny County, which owns most of these bridges, has declared itself willing to remove them and replace them with bridges at higher level and of longer spans. Such replacement was ordered by the War Department seven or eight years ago, but the county resisted the execution of this order almost continuously since it was issued, declaring the work to be unnecessary, beyond the financial powers of the county, and less important than other construction work which the county desired to undertake. In receding from this position, the county not alone terminates a deadlock harmful to its own interest, but it withdraws a challenge to the power and good judgment of the War Department in its function of administering river matters in the public interest.

Since the War Department's order that the bridges should be raised was first issued, the Pittsburgh interests have been constantly active to secure the revocation or at least the non-enforcement of the order. They appealed to each successive Secretary of War to review the case and overrule the judgment of the army engineers. Political pressure was brought to bear on the matter wherever possible. But appeals and political pressure alike failed of their object; each Secretary

of War affirmed the prior order, and upheld the judgment—and therefore strengthened the authority—of the engineers. Allegheny County based its protests on no principle, and was unable to advance a tenable reason or excuse for its protest attitude. In substance, it defied and challenged the effectiveness of federal river administration. There have been very few such situations since Congress turned over the administration of navigable streams to the War Department. Had the challenge succeeded it would have set an important precedent.

Apart from its relation to river control, the case illustrates some of the inefficiencies of dual government of a municipality. The city of Pittsburgh and the county of Allegheny have various overlapping and interlacing functions, as happens in a number of other communities. The county owns a number of the bridges over the Allegheny River, though they are located within the city and form a vital part of the facilities and necessities of city business, while the Monongahela River bridges and one or two of the Allegheny bridges are owned by the city. Any such arrangement necessarily results in divided responsibilities, a condition with many obvious disadvantages and few if any countervailing advantages. In the interests of efficiency in local government, it is desirable that such dual authority be abolished.

Nothing is added to the scope of federal supervision over navigable rivers by the final adjustment of the Allegheny County case. The practical application of this supervision, however, involves psychological factors that may profoundly influence its effect. As an example of the intrusion of such factors, the Pittsburgh case is likely to be of service in clarifying and strengthening the administration of river control.

Day Labor in Power Construction

ARGUMENTS for and against day labor construction have usually been based on the conditions that exist in public work, where the most serious criticism is directed to the possibilities of political control, with its attendant evils of favoritism and high cost. With the growing extension of large power systems, however, the question of the ultimate superiority of the contract method over the force account method enters another phase, one where cost is important but where the political argument cannot be made. Whether the contractor is going to be eliminated from these large power operations or not, the fact is that in many of them, particularly on the West Coast, the tendency is in that direction.

The two largest Western power companies are building extensive hydro-electric projects entirely on the day labor plan. To do this requires that the companies maintain large engineering and construction organizations as well as much expensive construction equipment such as is required for building roads, railroads, dams and tunnels, and in general carrying on heavy work in remote regions. The day labor basis leaves the companies free to change design or to alter construction schemes suddenly and without warning, and even to make such radical changes in program as diverting some millions of dollars of the season's construction budget from hydro to steam power (as was actually done in one notable case recently due to a severe drought).

The power company that undertakes to build with its own construction organization a chain of water power plants on some mountain stream can confidently buy high class construction equipment on the basis of using it throughout the entire series of plants. If this has to be hauled in under difficult conditions, the bulky loads can be moved without fear that they will have to come out before the job as a whole is finished. One Western power company recently spent $200,000 for construction equipment, much of it being of special design, which was delivered to a remote region to be used successively on a series of developments. It would not be economical to construct all the units in this series now; and even the question of whether they should be built one immediately after another depends on conditions that cannot now be foretold. Nor would it be desirable to decide now on the details of the work to be done—improvements in methods may be made and the present preliminary plans will doubtless be extensively revised by the time, several years hence, when construction on the later parts of the work is begun.

If the contract plan were to be employed on this work the power company would be justified in contracting at present only the first unit of the series. Thus in bidding and in selecting his equipment the contractor would have to figure that he might not get later units of the chain of developments and the heavy construction equipment taken in over the long haul might have to come out again after finishing only one unit of the series. The power companies, to be sure, have profited by methods developed in the best contracting organizations. Particularly in remote regions where many diversified operations are under way, some of the larger companies conduct their construction work much as military strategists maneuver a campaign; the keynote of operations becomes "the best means to the end" and the system is flexible in any way desired, unhampered by contract terms. Responsible charge is vested in one or two competent, energetic men who are natural leaders; these men are given a definite objective and with all necessary man-power and equipment are told to "build it." In such operations the power companies have not been slow either to take advantage of methods developed by contractors, such as the bonus system in tunnel work and similar schemes for interesting labor and speeding up production, or to use the facilities of a large organization in buying equipment and supplies and in employing men. Indeed, in the East one of the largest public utility companies has solved the problem by organizing a separate contracting company which, presumably, is the favored bidder on the work of the parent company but which also is prepared to do, and is doing, outside contract work.

It may be pointed out, in defense of the contract method for power construction, that so long as public rate control is based on investment there is no particular incentive for the public utilities to build as cheaply as possible. The rate-making body presumably will not allow a charge on an obviously excessive capital cost, but in pioneer work, such as that in the Western country, it would be difficult to prove that construction costs are too high. The contractor's main argument—that he can build more cheaply—is not apt to be subjected to proof. In spite of that, however, the conditions of development, as outlined above, are so peculiar that the power companies can hardly be blamed for building up their own construction forces.

Cold-Mix Rock Asphalt Production and Roadbuilding

Kentucky Rock Asphalt Distinguished by Its Silica Aggregate and Ability to Bond Without Heating—Gives Best Service Under Constant Traffic

ROCK ASPHALT was probably the original bituminous pavement. Its first use in America was about contemporaneous with the use of artificial mixtures using lake or petroleum asphalts, but its development as a paving material for years lagged far behind that of the artificial combinations. Early records of use, however, are of minor interest. Today in America rock asphalt is a recognized paving material of widely distributed use. As here employed it may be broadly classified as sandstone or limestone rock or as a heavy-oil or light-oil rock or as cold-mix material or hot-mix material. Its finer chemical and physical intricacies will not be examined. The present discussion will consider only cold-mix rock asphalt, which, more specifically, is Kentucky sandstone rock asphalt.

Published information from unbiased sources, on Kentucky rock asphalt production and roadbuilding, is inconsiderable. During 1922 and 1923 personal studies were, therefore, made of rock asphalt rural roadbuilding in Tennessee and Kentucky, and of pavements and paving operations in several cities and information was accumulated by correspondence from a much wider territory. Late in 1923 a visit was made to the quarries and plant of the largest producing Kentucky rock asphalt works in operation. The personal examination, therefore, proceeded from the asphaltic rock ledges through every operation of production to the finished pavement.

Production—Slowness in the commercial development of Kentucky asphalt rock has been largely because of its inaccessibility. In Edmonson County, where the

FIG. 1—QUARRY FACE OF KENTUCKY ASPHALT ROCK

highest developed deposits are, the workings are about 25 miles from railway and are reached overland only by a mountain road very nearly impassable to vehicles except in good weather. Access is by boat from Bowling Green up the Barren, Green and Nolin rivers, about seventy miles. Bowling Green is the shipping point. On the Nolin River about eight miles from the Green, are the rock deposits and reduction works. Here there is a company town of about 1,500 people all dependent on the rock asphalt workings.

The rock deposits are on the hillsides and tops at an elevation of some 125 ft. above the Nolin. The usable asphalt strata are from a few feet up to 35 ft. thick and the overburden varies about the same. The development areas have been determined by core drillings on 50-ft. squares for general exploration and by much closer coring for final stripping and quarrying. Development is determined on the basis of thickness of rock, its bituminous content and the length of haul to the crushers.

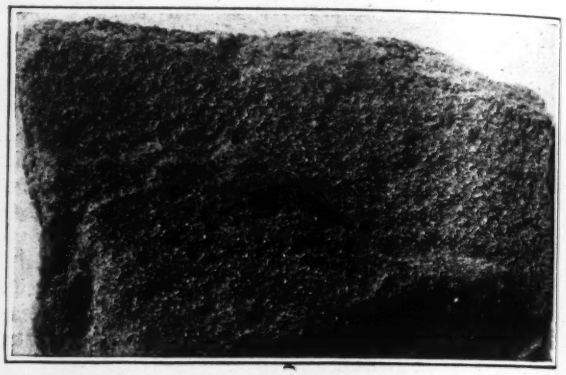


FIG. 2—TEXTURE OF KENTUCKY ASPHALT ROCK
Composed of sharp grains of silica bonded by bitumen, this rock is harsh to the touch and will scratch glass like diamond.

Mineralogically the rock is a sandstone impregnated with bitumen. Its appearance in ledge is shown by Fig. 1, which is a face, with the overburden removed, in one of the quarries. A close view showing the texture of the rock is given by Fig. 2. Fig. 3, which is a microphotograph of the rock reduced to its granular components, gives further indication of the nature of the material. The rock is a dark gray stone showing quite black when warm, when it is also slightly sticky to touch and gives off a faint tarry odor. The rock is hard and harsh; it will scratch glass. It runs from 3 to 10 per cent bitumen and the remainder is sharp-grained sand fairly well graded.

Treatment of the rock is in its general aspects very simple. Blasted to crusher size it is hauled in cars to the first crusher unit in the uppermost of the train of buildings shown by Fig. 4. Then it passes through crushers and crushing rolls which reduce it to its component sand grains without fracturing the particles. From the bin over the channel to the Nolin River the reduced product goes into scows and is towed some 70 miles to Bowling Green where it is unloaded and handled by cableway to cars or to stockpile, as indicated by Fig. 5, which is chiefly of interest as showing the appearance in stockpile where the material is stored in the open and may stay, in parts, for months without being disturbed and without deterioration.

The technology of the processes described lies in control which puts the product of the works examined on a plane of uniformity comparable with that of modern portland cement manufacture. Control begins in the selection of the ledge to be worked and ends

with an analysis of the carload before shipment. The purpose is to get a product containing between 7.0 and 7.5 per cent bitumen, and to keep it as near 7.15 per cent as possible. The blasted rock is first hand-sorted and the proper mixture of lean and fat rock is put onto the cars going to the crushers. Analysis of the quarry rock is made frequently, but the sorters are so expert that by the color of the freshly fractured rock they can tell, within one per cent, the bitumen content.

It is of significance to keep the fact of control carefully in mind. While there is nothing at any stage of the process added to the natural rock and so the reduced rock is wholly a natural material, it is artificial in the sense that it is a carefully directed remixture of the natural rock. Essentially, Kentucky rock asphalt is a manufactured material—as truly so as is portland cement although the mechanical processes and technology are much more simple. Emphasis is made of this fact because it is vital in appraising the quality of Kentucky rock asphalt as a road surfacing material.

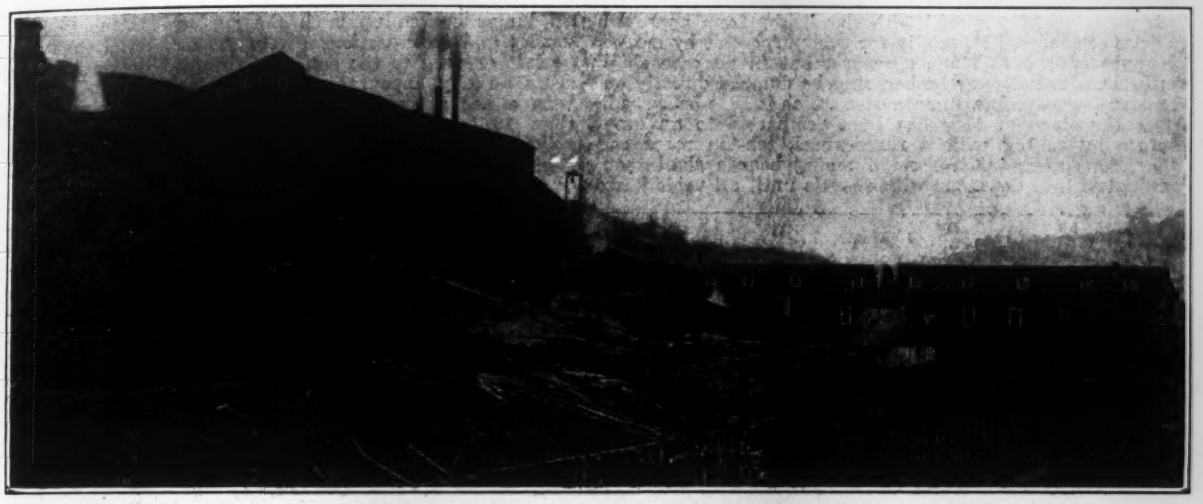


FIG. 4—KENTUCKY ROCK ASPHALT PLANT AT KYROCK, EDMONSON COUNTY, KENTUCKY
Reduction begins by coarse crushing in the topmost building and is a continuous process of crushing, grinding and belt conveying to the bins over the boat channel.

In the travel from one to another of the series of crushers and rolls the rock fragments are mixed several times and the final powdered product is analyzed ton by ton as it passes along. There are laboratories at the works and at Bowling Green, where a final shipping analysis checks all the tests that have gone before.

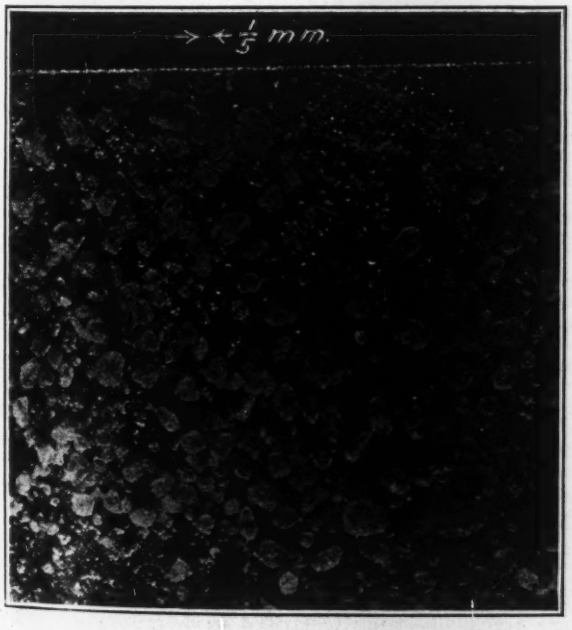


FIG. 3—GROUND ROCK ASPHALT MAGNIFIED 10 DIAM.
The original photograph indicates plainly the translucent silica sand grains. The sample was not selected and picture represents run of product as shipped for paving use.

Road Design and Structure—Rock asphalt, it must be remembered, like sheet asphalt mixture, is a road surfacing material. It requires a base structure which may be any of the types used for sheet asphalt mixture. In prevailing practice a broken-stone base—macadam, telford or their combination—is constructed. Consideration here will be limited to this type of construction. Figs. 6 and 7 are examples.

In practice, requirements for Kentucky rock asphalt are not uniform. Both the fineness and the bitumen content vary. The manufacturers' specifications set the limits of bitumen at 6½ to 7½ per cent and require 90 per cent to pass a 1-in. screen, 80 per cent a ¾-in. screen and 70 per cent a ½-in. screen. Greater fineness, 95 per cent through a ¾-in. screen, is required by the engineers of the Kentucky state highway department. Not less than 6 per cent bitumen is specified. For Tennessee state road work the bitumen limits are put at 7 to 9 per cent and "the material shall be ground as finely as possible and shall not contain an excess of lumps."

Advanced rural road construction is indicated by Fig. 6 which shows Kentucky state highway practice. The depth of pavement, 13 in., is for a special case; ordinarily the thickness of base is 8 to 10 in. Virtually complete waterbound macadam-telford construction methods are followed. The binding course of macadam is well built. The specification, condensed, is:

> The bonding course shall be constructed of broken limestone or broken slag forming the following grading:
>
> Passing 2½-in. laboratory screen..100 per cent
> Retained on 1½-in. laboratory screen, not less than.....90 per cent
>
> This material shall be dumped on dumping boards and

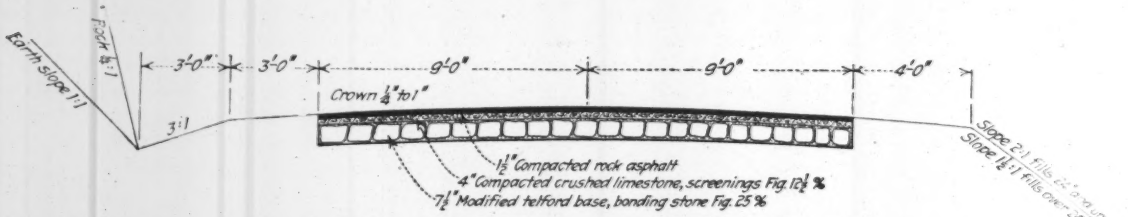


FIG. 6—STANDARD KENTUCKY STATE ROAD OF ROCK ASPHALT

then very carefully spread with shovels, or from approved vehicles constructed especially for this purpose or by means of approved broken stone spreader, but in no case shall the broken limestone or broken slag be dumped directly on the base course within an area over which it is to be spread. After the stone or slag has been compacted to an even surface by rolling with a three-wheel, ten-ton macadam roller, screenings taken from dumping boards shall then be whipped into the stone with shovels until all voids have

FIG. 5—ROCK ASPHALT STOCKPILE AT SHIPPING YARDS

been filled to within one inch of the surface. No other method of applying screenings will be permitted.

Rolling shall then continue until the screenings have settled around and bedded the stone or slag. The surface shall then be thoroughly sprinkled and rolled until the broken stone or slag is well set. If necessary, other applications of screenings shall be made and rolling continued until the voids are uniformly filled to within 1 in. of the surface of the bonding course. Where the filling reaches above this point the excess screenings must be swept out with brooms. The bonding course shall be placed in such a manner and be so protected by plank runways as not to be driven over or disturbed by vehicles hauling rock asphalt.

Putting on the rock asphalt surface is much like putting on sheet asphalt mixture except that the rock asphalt is put on cold. The specifications for Tennessee state roads describe good practice.

All material shall be dumped on dumping boards of approved type and size and spread uniformly by hand or by wheelbarrow from the dumping boards, being carried forward in two lines forming a V at their intersection with the center of the road, the sides of the V being at an angle of approximately 45 deg. with the center line. In no case shall the material be dumped directly on the base. After spreading, the material shall be carefully raked and all lumps broken up until the surface is true to lines, grades and cross-sections given. The material shall then be left exposed to the sun and air until the surface presents an oily appearance, after which it shall be rolled with either a three-wheel power roller weighing not less than 10 tons, or a well-balanced self-propelled tandem roller weighing not less than 8 tons. The rolling shall begin at the sides and progress toward the center parallel to the center line. The rolling shall continue, overlapping each preceding track, until the entire surface has been thoroughly covered by the roller and until a monolithic surface is produced. If any depressions or irregularities appear after the rolling, they shall be corrected by raking and by adding material. The surface shall be thoroughly rolled each day for at least three consecutive days thereafter. If marks continue to appear from the roller wheels, the surface shall be cross-rolled with a well-balanced tandem roller until the roller marks cease to appear and the surface is compact, smooth, and free from all roller marks, irregularities and depressions. No rock asphalt shall be laid in wet weather, or when the air temperature is below 50 deg. F. No material shall be laid when the base is not thoroughly dry.

Corresponding good practice in street paving is indicated by Fig. 7. As worked out in long experience by William W. Southgate, city engineer of Nashville, Tenn., construction is as follows:

For new grading and paving, excavate and prepare the sub-foundation usually at a depth of about 11 or 12 in. below and parallel with the finished contour of the pavement. For the bedding course use "one-hand stone" hand placed flat on the sub-foundation closely together and then carefully gone over with 16-lb. spawling hammers, being careful to crack every stone and leave the surface of the bedding when properly cracked, showing about 3 or 3½ in. diameter stones all over. This bedding course is then rolled under a 10-ton road roller and keyed up with limestone screenings passing through a ¾-in. to 1-in. mesh and finished to a fairly uniform thickness of not less than 6 in. after final compaction. The crushed limestone binder course passing a 2½-in. mesh screen and caught on a ¾-in. mesh sieve is then spread over the bedding course and carefully rolled and stabilized with just sufficient limestone screenings not quite to fill the voids and with no surplus screenings over the surface so as to form a uniform layer of 3½ in. thickness after final compaction.

The pulverized Kentucky rock asphalt is then carefully spread over the prepared macadam foundation in a uniform thickness of from 2¾ to 2½ in. when loose and rolled preferably with an 8-ton tandem roller until final compaction and until true to the established contour of the roadway with a uniform thickness of not less than 1½ in.

Only representative practice is of course indicated by the examples given. As in other types of roads, practice in details differs with the ideas and purposes of the directing engineer. However, the examples are from the practice of engineers whose experience has been extensive in the territory where Kentucky rock asphalt is virtually the native road building material.

Construction Procedure and Plant—The general construction features of cold-mix rock asphalt road work are perhaps best particularized by describing a specific operation selected for the excellent manner in which it was conducted. Except to state that it was a Tennessee state road built with federal aid, the operation

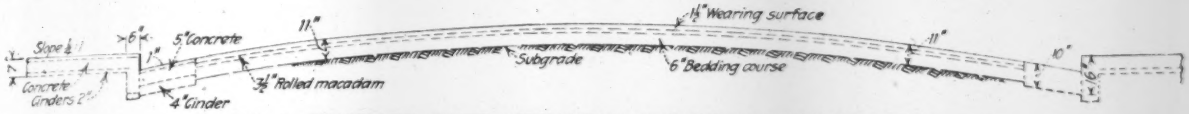


FIG. 7—STANDARD ROCK ASPHALT PAVEMENT, NASHVILLE, TENN.

is not identified. About 10 miles of old 12-ft. water-bound macadam road was improved by surfacing with rock asphalt an 8-in., hand-placed stone-base course, with a 2-in. binder course of broken stone.

By scarifying and blade grading the original macadam was broken up and spread out to a width of 18 ft. The subgrade was finished by hand. Five lines of grade stakes 50 ft. apart along the grade were set by the engineer, one line on each edge, one at the crown and one midway between the crown and each edge. Cords stretched longitudinally between stakes guided the pick and shovel men and a profile very close to the theoretical section and grade was easily possible. The subgrade was crowned to a parabola having a 3-in. rise.

In hand-placing the base-course stone, cylindrical blocks of wood 8½ in. high were set 8 ft. apart along the grade in five lines corresponding to the lines of grade stakes. This arrangement proved excellent for guiding the workmen in the most important task of keeping the base-course surface parallel to the final road surface. The stones were placed with care to secure the maximum bearing and the closest possible spacing; as a rule they were selected so that each reached from subgrade to base surface. After placing the large stones, quarry spalls and other wedge-shaped stone were dropped by hand vertically into the voids between stone. Care was taken, it should be said also, to set the large stone as nearly vertical as possible, and as nearly at right angles to the direction of the center line of the road as possible. After placing and wedging the voids, the surface of the base was napped so as to break up any angular points which projected above the general level. However, not a great deal of work was required in napping the base, because of the uniformity of the stone, and the great care exercised in placing them.

After napping the surface of the base was thoroughly rolled with a 10-ton roller until all stone was thoroughly compacted and wedged. The contractor found it advisable after shaping his subgrade to haul this stone and dump it directly upon this subgrade for a distance ranging from half a mile to one mile from the place where he was laying base. He generally kept from four to six gangs laying base, these being placed at intervals of about 75 ft. He also generally used about four men to each gang placing stone and the average rate of placing was about 75 lin.-ft. per day for each gang of four men. After thoroughly rolling, the voids in the main stone composing the base course were filled with screenings. Nothing but pure screenings was used as a filler; that is, only material passing through a ¾-in. circular opening and including dust. These screenings were applied carefully, broomed into the voids by hand and the surface was again rolled, the application of screenings, brooming, and rolling continuing at the same time until all voids were filled.

After all the voids in the main stone had been filled a smoothing layer of stone was spread to a uniform depth of 2 in. over the base course. This stone consisted of material passed over a ¾-in. circular opening and through a 2½-in. circular opening. It was spread very carefully and in such a manner that the finished surface was perfectly uniform, free from all depressions and waves, and exactly parallel to the finished surface. A definite thickness of stone was used in all cases. After spreading this stone and just previous to the spreading of the rock asphalt this smoothing layer was lightly rolled, just sufficiently to set the stone thoroughly into the base course and to smooth the surface and not sufficient materially to crush the stone composing this layer.

The rock asphalt was then applied directly upon the finished base course. It was hauled in trucks and dumped on dumping boards placed immediately ahead of the point of application. It was transported by hand with forks from the dumping boards to the rolled surface,

FIG. 8—ROCK ASPHALT PAVEMENT UNDER CONSTRUCTION, NASHVILLE, TENN.

spread and smoothed with rakes. It was spread to a uniform depth of 2¼ in. loose. Square wooden blocks having a uniform thickness of 2¼ in. were used to gage the depth. One ton of rock asphalt covered about 15 sq.yd. of pavement. Extreme care was taken to see that no rock asphalt was laid in wet or damp weather and at no time when the temperature of the air was under 60 deg. F. It was found that it was impossible to obtain satisfactory results except when the material was thoroughly dry and except when it was alive and presented a black, oily glistening surface. After the material was spread in this condition it was rolled with a 10-ton roller. On hot days the best results were obtained by rolling late in the afternoon or early in the morning. Also good results were obtained by back rolling the material for two successive days.

Simplicity of procedure and plant, it will be observed, characterize the construction operation. Besides the hauling outfit, a roller is the only major equipment. As the asphalt mixture is laid cold immediate rolling, although it is generally practiced, is not essential; if traffic is kept off the asphalt it can be rolled any time within several days after spreading. Very thorough rolling is always essential. Rain interrupts construction as there must always be a thoroughly dry subgrade. Cold retards bonding and compacting and the usual

requirement is that asphalt must not be laid when the temperature drops below 50 deg. In instances, however, it has been laid when it was much colder and has ironed out perfectly. As the view Fig. 8 indicates, the cold-mix rock asphalt does not show, when first rolled, the slick, tight surface texture which characterizes hot-mix sheet asphalt work, but cohesion soon becomes perfect and the surface irons out under traffic.

Service and Maintenance—Older roads of cold-mix asphalt were built of material less rigorously controlled and service results are, therefore, somewhat erratic. In many cases observed the surface faults were obviously results of base or foundation failures. A notable observation in all instances was that the asphalt retained its integrity as a material. Pavements 35 years old were cut into and examined for this evidence.

In particular, experience shows, cold-mix Kentucky asphalt roads require use, the ironing action of constant motor-car traffic, for endurance.

Surface maintenance is simply the task of cold patching. With the place to be patched well cleaned and painted with asphaltic cement or cut-back asphalt, the new material is added and rolled or tamped in place.

Acknowledgment—In preparing this article aid was received from the state highway departments of Tennessee and Kentucky, from the city engineering department of Nashville, Tenn., and from the executive and technical staff of the Kentucky Rock Asphalt Co., Louisville, Ky.

Heavy Hammer Needed in Driving Large Piles

Load Capacities Calculated From Test Piles in Deep Clay Soil Found to Depend on Weight of Hammer

By J. N. Laycock

Lieutenant, Corps of Civil Engineers, U. S. N., Balboa, C. Z.

PRACTICAL piledriving men often say flatly, "The hammer test can't lie." The statement is perfectly true, but, just as is the case with figures, the message, though truthful, is sometimes downright misleading. This was the case with certain test piles recently driven preliminary to the construction of a Navy pier.

These test piles, driven with a steam hammer having a 5,000-lb. ram and 36-in. stroke, showed capacities computed by pile formula greatly in excess of those developed by the permanent piles driven later with a steam hammer having a 7,500-lb. ram and 39-in. stroke. The discrepancy between the results in the two cases was found to be due primarily to the difference in the hammers, as was proved by driving one of the permanent piles with the lighter hammer. This pile showed exaggerated results similar to those of the test piles.

The pier construction contemplated precast concrete piles 18 in. square and about 80 ft. long, of uniform cross-section except at the tapered point, with each pile carrying 40 tons. Borings on the site had shown water and soft silt extending down to elevations varying between —28 and —43 ft. (m.l.w.). Below this material a fairly compact and uniform blue clay was found extending down to El. —90 or —95. Below the clay was sand and marl. Three round wood piles, driven to El. —80, indicated a fairly uniform consistency of material penetrated.

As the relative resistance of the small wood piles and the much larger concrete piles was uncertain, four timber test piles were built up of the size proposed for the concrete piles. The results obtained are shown in Fig. 1. The driving was performed with a steam hammer having a 5,000-lb. ram and 36-in. stroke. Two of the piles were driven a short distance with a drop hammer before driving was stopped, but the curves of the drop hammer results are not particularly significant on account of the condition of the piles at this stage. One feature of these curves is particularly interesting, the fact that *in most cases the piles lost resistance when driving was suspended.*

Such inconsistent curves as those in Fig. 1 naturally caused concern. It was expected that with a larger hammer more consistent results would be obtained, and that a curve drawn through the low points of the test-pile curves would safely predict the results to be expected with the concrete piles (such a curve is shown in Fig. 1).

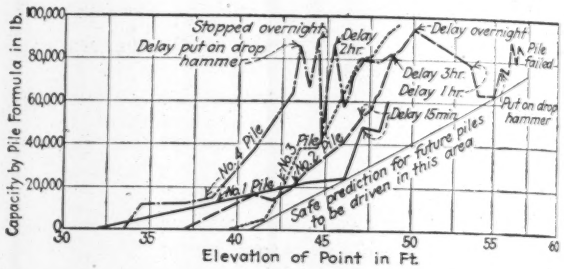


FIG. 1—BEARING-VALUE CURVES FOR TEST PILES DRIVEN WITH LIGHT HAMMER

Piles 18 x 18 in., built-up, with points 8 in. square and taper 34 in. long. Driven by 5,000-lb. steam hammer with 36-in. drop except latter part of driving of Pile 4, which was soon injured by the drop hammer. Carrying capacities calculated by formula $\frac{2\,Wh}{s+0.3}$ for steam hammer and $\frac{Wh}{s+1}$ for drop hammer.

By the time the first concrete piles were ready, a steam hammer with 7,500-lb. ram and 39-in. stroke was available. Fig. 2 shows the results of driving seven concrete piles. Six of them were driven with the heavy new hammer and one of them (52 C) with the 5,000-lb. hammer. Whereas the safe curve sketched in Fig. 1 had promised 80,000 lb. capacity at about El. —58, the mean of the curves in Fig. 2 would not be higher than 40,000 at that depth. It will be noted that the pile (52 C) driven with the lighter hammer has the objectionable features found in Fig. 1, i.e., its computed resistance rises to exaggerated heights during continuous driving and falls when driving is suspended.

The misleading results obtained with the test piles were a source of delay to the construction, but the test piles really performed a useful function in pointing out the need for a larger hammer. The conclusion that a heavier hammer would reduce the exaggeration of the resistance curves is derived from the following analysis:

The piles are embedded in a stratum of clay extending down to about El. —95. A certain amount of settlement required to produce a stressed (or elastically deformed) condition in the supporting medium would be expected in loading such piles.

The elasticity of the hammer, cushion, pile, and clay absorb part of the energy of each blow, as they must each reach a certain state of stress and elastic deformation before the pile can start actually displacing the clay. The balance of the energy of the blow remaining

after reaching the state of maximum elastic deformation which the clay will stand is available for displacing the clay.

When the blow has spent its force, that energy which has been stored up in elastic deformation tries to expend itself in a rebound. If there is a large amount of friction on the sides of the pile, as in the case of the ordinary wooden pile, which is tapered throughout its length, much of the rebound is effectively resisted and the elastic deformation of the clay is not relaxed, with the result that there is not a corresponding waste of energy on successive blows. The piles of Figs. 1 and 2 were of uniform cross-section except for tapered points 2 ft. 10 in. and 4 ft. long respectively. It is reasonable to assume that their side friction was insufficient to prevent a considerable rebound and that the rebound played an important part in producing the discrepancy between the results with the different sized hammers.

The following numerical example shows how the

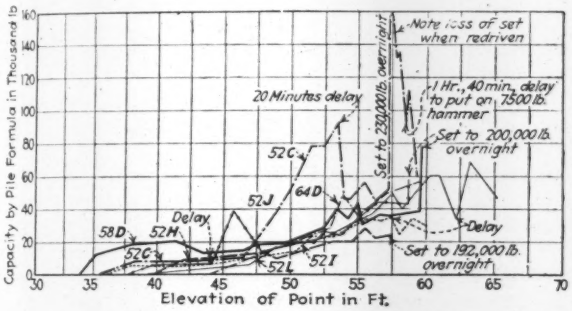


FIG. 2—BEARING-VALUE CURVES FOR CONCRETE PILES DRIVEN WITH HEAVY AND LIGHT HAMMERS

Piles 18 x 18 in. Driven with 7,500-lb. steam hammer except Pile 52 C, which was driven with steam hammer having 5,000-lb. ram. The latter is the only pile which lost capacity when driving was interrupted. Carrying capacities calculated by formula $\frac{2\,Wh}{s\left(1+0.3\frac{w}{W}\right)}$ where W is weight of hammer, w is weight of pile (23,600 lb.), h is fall of hammer in feet, and s is penetration per blow in inches.

rebound exaggerates the computed pile capacity. If 75 per cent of the energy of a hammer is used up in elastic deformation corresponding to rebound, the computed pile capacity will be four times as large as it should be. If we drive the same pile with a similar hammer having twice the energy, the same loss is only 37.5 per cent of the hammer energy and the indicated pile capacity is only about 1.6 times as large as it should be. The effect of rebound in this assumed case is to make the capacity indicated by the light hammer 2.5 times as large as that indicated for the same pile by the heavier hammer.

It is therefore apparent that the results with the light hammer will be much more sensitive to variations in the rebound tending to make the curve more irregular. The gradual loss or distribution of stress in the clay during a delay in driving would therefore produce a greater drop in the curve of pile resistance for the lighter hammer. This effect is found in the curves in Figs. 1 and 2.

It will be noted that the pile formulas used in computing the curves in the two figures are different. A comparison of the two formulas in this case has shown that up to 40 tons the difference is minor, and that the formula used in Fig. 2 is slightly the more conservative.

The conclusion that under the existing conditions a given hammer would not satisfactorily drive piles of this type larger than a certain size was further confirmed by subsequent tests for which the curves are not shown. In these tests the cross-section of the pile was increased above the tapered point. When using the heavier hammer, greatly exaggerated computed capacities during continuous driving, and excessive loss of capacity when driving was suspended, similar to the curve of pile 52 C (Fig. 2), were encountered when the cross-section was increased above a certain amount.

In driving large piles of uniform cross-section the engineer will do well to plot the curves at least for his test piles superposed as in the accompanying figures. If these curves are erratic he should seek the source of the trouble which may lie in the weight of hammer. Further significant information may be gained by redriving after intervals of delay as was done in this case.

Prospects of Wood Preservation by Zinc Chloride

Abstract of an address at the annual meeting of the American Wood Preservers' Association, at Kansas City, by Herman Von Schrenk, consulting engineer, St. Louis, Mo.

AS A RESULT of numerous failures and disappointments a good deal more attention is being paid to zinc chloride than ever before, and I have a strong feeling that zinc chloride has a large place in the wood preserving industry, particularly when we consider that in the decision as to what preservatives shall be used the controlling factor is the financial risk in making the investment. This financial risk in preserving ties, car material or bridge timbers has to be viewed not only from the preservative angle but also from the wear angle or the angle of the mechanical service of the material. From the latter viewpoint the cheapness in the initial investment with zinc chloride is a very important factor, particularly when we know we can at least double the life of ties by proper use of this material. If we could get sufficient creosote we probably would use creosote in the impregnation of all material where it is suitable, but as that is not possible we have to use other preservatives.

Experience with zinc chloride clearly indicates that in its use very much more careful chemical and physical control has to be exercised, not only of the solution and the treating process but also of the subsequent handling of the material. Mr. Pooler, of the C., M. & St. P. Ry., says he has zinc-chloride ties that have been in service twenty years. Some of them look as if they had been laid yesterday. We were unable to find any chlorine in them, but still the ties were sound. The theory that chlorine is the absolute factor in the preservation by zinc chloride may or may not be substantiated by the results on those ties.

The relation of solution temperatures to penetration may be another index of the progress in getting better service from zinc chloride, while addition of petroleum to zinc chloride may carry us still farther as to the possible life of ties treated with zinc chloride. No one who looks at those ties in the Santa Fé or Southern Pacific tracks can help feeling impressed with the remarkable appearance of the zinc ties treated with petroleum. The risk appears to be very small and the few operating difficulties which have been found in treatments probably can be overcome easily.

Referring to the zinc treatment for various types of lumber, there is considerable interest in more economical use of wood in car and building construction. In car material this includes not only sills but also the upper portions, that have to be painted. Objections have been made that possibly the zinc solution would stain the paint. But experimental painted panels that we put up a little over two years ago look as good as when they were new.

This preservative has given us better service than many of us realize, and the failures we have had are due either to improper application or to improper use in regions where it should not have been used, but that is no indication that we should not keep working at it and make the best possible use of what is really a very valuable preservative.

Determining the Cement Content of Concrete

A Chemical Method of Analyzing Concrete Based on the Silica Content—Check Results Given

By Herbert F. Kriege

Chemical Laboratory, State Highway Commission, Jefferson City, Mo.

In commercial and experimental work it is frequently desirable to know the actual cement content of a specimen of concrete. As it is usually impossible to obtain samples of the materials used in the concrete, an analysis, if made, must be of the specimen at hand. Since no scheme of chemical analysis of concrete for its cement content could be found, the method presented in this paper was devised.

Chemically the elements composing the cement and the common aggregates are the same. Both contain silica, alumina, ferric oxide, calcium oxide, magnesium oxide, the alkalies, sulphur trioxide, and small amounts of other substances. While no ready method for the separation of these constituents of cement and aggregate seems available, there is an essential difference in the state of combination of the silica in the two. It occurs as the mono-, di, and tri-calcium silicate in cement, while in the aggregate it is either free or combined as some impure aluminum silicate. Upon this state of combination depends the following procedure, since the silica will be set free as silicic acid from the calcium silicates by reagents which will not attack it appreciably in the form of free silica or as alumino-silicates. As silicic acid it may be carried through a filter because of its colloidal nature or dissolved by an alkali and filtered off.

In brief, then, the plan is to treat the sample of finely ground concrete with an acid which will liberate the silica from the calcium silicates and follow this action with alkali washes until all the silicic acid formed has been carried into the filtrate either in solution or in suspension. The solution is then analyzed for silica from which the amount of cement present in the sample is calculated. This is done by assuming that the silica content of the cement (if its true content is not known) is between 21 per cent and 22.5 per cent. The factor 21.75 per cent is used as it is near the actual average of the silica of well known brands of cement.

Preparation of the Sample—Every precaution must be taken to have the sample of concrete used for analysis truly representative of the whole specimen considered. Since we are dealing with a mixture of small and large particles, it is difficult to maintain uniform distribution of the cement and aggregate. A portion weighing 10 lb. or more should be taken to avoid all but slight inequalities of the concrete mix. This portion is then broken up, crushed in a suitable machine to about ¼-in. size, and reduced to a fineness of from 150- to 200-mesh in a ball mill or other pulverizer. Care must be taken that the fines, which are richer in cement, are not discarded or lost. After thorough mixing and quartering, a portion of 100 grams is taken. Bits of iron from the pulverizer may be found in the sample, which should be worked over with a strong magnet. The clean sample is then dried at 110 deg. C. for at least two hours.

Method—Weigh into 250-c.c. beakers three or four portions of about ten grams of the prepared sample. Moisten with a stream of hot water and by stirring prevent adhesion to the beaker or the formation of lumps in the mass. Slowly add 100 c.c. of 3.3 normal hydrochloric acid and stir thoroughly. The lumps which tend to form should be reduced with the glass rod. After the evolution of carbon dioxide has ceased and the reaction is apparently complete, the contents of the beaker are allowed to settle for a few minutes. Decant through an ignited and weighed Gooch crucible which contains a mat of short asbestos shreds thick enough to be opaque to light. Retain as much of the residue in the beaker as possible. Wash by decantation twice with hot water. Add 75 c.c. of normal sodium hydroxide solution to the residue with stirring and heat to about 75 deg. C. Decant as before and wash twice with hot water. The residue is then transferred to the crucible and washed with at least 60 c.c. of hot water. The suction should be regulated for a rapid rate of dropping during filtration.

The filtrate now contains the silica in the form of silicic acid either in true solution or in suspension in the hydrochloric acid medium. Tranfer to a suitable beaker, with several rinsings of the filter flask. The solution is evaporated to dryness, baked at hot plate temperature for an hour, the residue moistened with concentrated hydrochloric acid, evaporated and baked again, and then taken up for filtration in 75 c.c. of two to three normal hydrochloric acid solution heated to boiling. Filter through an ashless filter-paper, wash the residue with 50 c.c. of hot normal hydrochloric acid solution and then with hot water until the washings are free from chlorides. Ignite to constant weight in platinum crucibles, moisten the residue with 6 normal sulphuric acid and add 15 c.c. of hydrofluoric acid. Evaporate to dryness on the hot plate, heat cautiously at first, then to bright redness over a Bunsen flame until constant weight is obtained. The loss in weight represents the silica liberated in the process. In case platinum crucibles are not available the residue containing the silica may be ignited in a deep porcelain crucible. To this add 2 or 3 grams of potassium bisulphate crystals and heat on a hot plate until a quiet fusion is obtained. Then very carefully heat with a gentle flame until most of the gases are expelled and finally until a clear cherry red fusion results. Cool, place the crucible and contents into 250-c.c. beaker which contains 100 c.c. of one to ten sulphuric acid solution. Heat until the fusion cake is completely dissolved, filter through ashless papers, wash until free from sulphates and finally ignite and weigh as silica. The percentage of cement in the sample taken is determined by dividing the percentage of silica found by the factor 21.75 per cent.

Check Results—The data obtained by the application of this method to various forms of concrete are given hereinafter. Most of the specimens were taken from briquettes, beams and cylinders prepared in this laboratory for tensile strength, breaking and crushing strength respectively. The kind of cement, the kinds of aggregates and the weights of each used were known to A. D. Conrow, but were unknown to the operator until the analyses had been completed.

Since the constituent determined is but a small part of the original sample, four or more portions of the same sample were run in most cases. This gave information as to the reliability of the method, since it would be worthless if there was not fair uniformity in the various runs on the same sample. An extreme variation of more than 0.4 per cent SiO_2 was found in a few cases.

TABLE I—CHECK ON MORTAR MIXES ANALYZED

No.	Mix Found	Per Cent	True Mix Used	Per Cent	Samples Run	Description of Sample
1	1:5.29	15.89	1:5.35	15.75	6	90-day test beam, white flint and limestone aggregate
2	1:3.1	24.4	1:3.0	25.00	2	Briquette
3	1:5.73	14.87	1:5.67	15.00	4	Briquette
4	1:4.42	18.46	1:4.35	18.69	4	Joplin flint, chats aggregate
5	1:5.00	16.67	1:5.30	15.87	4	Disintegrated chert aggregate
6	1:6.29	13.74	1:5.82	14.67	5	Weathered flint and crushed flint
7	1:6.35	13.61	1:5.82	14.67	4	Weathered flint, crushed flint
8	1:5.69	14.94	1:5.70	14.95	4	Bethany Falls Limestone, Mo. R. sand
9	1:6.07	14.16	1:5.82	14.67	3	Weathered flint, crushed flint
10	1:5.08	16.45	1:5.24	16.04	4	Weathered flint, crushed flint. Frozen 5 times
11	1:5.10	16.40	1:5.24	16.04	4	Weathered flint, crushed flint. Not frozen
12	1:5.96	14.40	1:5.80	14.71	5	Meramec R. Gravel, Mo. R. Sand
13	1:5.43	15.58	1:5.80	14.71	4	Limestone, crushed flint
14	1:5.53	15.31	1:5.80	14.71	4	Limestone, crushed flint
15	1:5.43	15.58	1:5.80	14.71	4	Limestone, crushed flint

Table II contains the results obtained in the analysis of a number of briquettes composed of varying amounts of standard Ottawa sand and a sand-cement mixture. Before making up the briquettes the cement used was mixed with differing amounts of Missouri River sand and pulverized in a ball mill. This sand-cement mixture was then used as straight cement in making 7-day tensile strength briquettes having a 1:3 mix according to A.S.T.M. methods. These, ground, served as samples.

Since is was feared that some of the cementing material is lost in the making of briquettes thus altering the true mix, portions of the samples used were run for total calcium oxide also in the usual method for calcareous minerals. Knowing the cement and the kinds of sand used, as well as the calcium oxide content of each, the actual cement value of each sample is easily determined, as shown by heading "True Cement Content."

TABLE II—DETERMINATION OF CEMENT CONTENT

Serial Number	Cement by SiO_2 Method Per Cent	Mix	True Cement Per Cent	Content Mix
0	23.62	1:3.23	23.36	1:3.28
1	20.83	1:3.81	21.74	1:3.61
2	20.51	1:3.87	21.02	1:3.76
3	19.38	1:4.16	19.42	1:4.15
4	18.71	1:4.35	18.85	1:4.31
5	16.95	1:4.90	16.32	1:5.13
6	16.46	1:5.08	16.64	1:5.01
6-A	16.82	1:4.95	16.73	1:4.98
7	14.39	1:5.95	15.18	1:5.59
8	13.56	1:6.38	14.36	1:5.96
9	13.26	1:6.54	13.50	1:6.42
10	12.19	1:7.20	12.38	1:7.08
11	12.14	1:7.23	12.05	1:7.30

In each of the above analyses, four check samples were run.

Determining Insoluble Matter—There is always a small portion of a cement sample determined as "Insoluble Matter" in the usual chemical analysis. Since the procedure presented here does not expose the cement in the concrete to such rigorous solvent action, the percentage of the cement remaining out of the solution would be larger than the actual "Insoluble Matter." To ascertain just what amounts would resist solution sixteen brands of cement at hand in the laboratory were run by the method used for concrete.

The portion remaining out of solution was less than one per cent, the average being 0.49 per cent. Since the amount of cement in concrete is usually from 12 per cent to 25 per cent, the value of this insoluble matter in the cement falls to 0.06 per cent to 0.12 per cent for the entire concrete. Here samples of five grams were taken.

TABLE III—"INSOLUBLE MATTER" ANALYSIS

Brand	A	B	C	D	E	F
Per cent insoluble	0.26	0.06	0.42	0.08	0.09	0.42
Brand	G	H	I	J	K	L
Per cent insoluble	0.88	0.19	0.48	0.34	0.72	0.89
Brand	M	N	O	P	Average Insoluble	
Per cent insoluble	0.86	0.54	0.60	0.99	0.49	

The reagents hydrochloric acid and sodium hydroxide which are used to liberate the silica from the calcium silicates will also attack the silica somewhat in its other forms. This action will be very slight because of the temperatures employed and the time given the solvents. For reference on the point of silica solubility see "Analytical Chemistry," Treadwell-Hall, Vol. 1, p. 403. To determine the effect of the reagents upon some representative silicious masses, samples of Ottawa sand and Missouri River (Jefferson City) sand were prepared and treated as the concrete had been. It will be seen that the small error caused by the solution of some of the silica will be one of gain in the calculation of the cement content and that it will therefore nearly compensate the small error of loss caused by the insoluble matter.

This value will have to be reduced proportionately with the silicious aggregate when applying it to concrete corrections. In case the corrections are not made, the error is too small to affect the results seriously.

TABLE IV—SAND ANALYSES

				Average Per Cent
	Ottawa Sand			
Sample wt.	4.5116 g.	5.0512 g.	5.4455 g.	
SiO_2 Diss.	0.12 per cent	0.13 per cent	0.11 per cent	0.12
	Missouri River Sand			
Sample wt.	5.0796 g.	5.1188 g.	5.2530 g.	
SiO_2 Diss.	0.13 per cent	0.13 per cent	0.15 per cent	0.14
			Total Average =	0.13

Aggregate Constitution—No effort was made in this investigation to determine the constituents of portland cement concrete other than the amount of cement used. It should be noted, however, that this method does give information as to the approximate analysis of the aggregate, that is, as to its carbonate and soluble parts or those silicious and insoluble. Thus if the insoluble residue obtained is but a few per cent, the aggregates both coarse and fine are limestone chiefly. If a mixture of cement, sand and limestone is used, the sand alone will remain as insoluble matter.

In Bulletin No. 61, Engineering Experiment Station, Iowa State College of Agriculture, George W. Burke describes a method for "Estimation of Constituents of Portland Cement Concrete." The plan involves a method of mechanical reduction and complete screen analysis followed by chemical analyses of the sand-cement portions passing ¼-in. mesh. In this way both fine and coarse aggregates as well as cement are determined. There are dangers worthy of consideration, however, such as breaking down the more friable aggregates by the rubbing, the chance of adherence of the cement to the aggregate and the disintegration of the aggregate such as gravel by ignition either through expansion stresses or by the expulsion of water. When one is not concerned with the separation of the aggregates and their estimation and only the cement content of a portland cement concrete is desired, the purely chemical analysis above set forth gives results fully as accurate.

The method as presented does not apply to concrete with aggregates of basic slag or similar material, as these will also liberate silicic acid when treated with dilute mineral acids.

Appreciation is hereby expressed to A. D. Conrow and the men of the Physical Laboratory for the preparation and the checking of the samples and to N. Eisen, C. R. Fisher and H. F. Dean for their assistance in making the analyses. The method was worked out under the direction of F. V. Reagel, Engineer of Materials of the Missouri State Highway Commission.

New Tie-Treating Plant on the Oregon-Washington R.R.

Four Retorts for Zinc-Chloride Process—Long Narrow Tie Storage Yard Served by Hammer-head Gantry Crane — Fireproof Building and Fire Protection for Yard—Methods of Treatment

IN CHANGING the location of its wood-preserving plant from Wyeth to The Dalles, Ore., the principal reasons which governed the Oregon-Washington Railroad & Navigation Co. were better labor conditions, greater convenience of site and reduced rainfall. The new plant at The Dalles, on the Columbia River, is about 84 miles east of Portland, and although this place is only 34 miles east of Wyeth it has an annual precipitation of only 15 in. as compared with 80 in. at Wyeth, where the excessive rainfall materially retarded the seasoning of timber in the storage yards. In addition, there was much greater storage area available at The Dalles, while the more convenient living conditions reduced to a marked extent the dependence upon floating labor. The plant at Wyeth was put in operation in 1904.

The new site is on a comparatively level area of sandy soil. About 236,000 cu.yd. of earthwork were required in leveling the site, 186,000 cu.yd. of gravel being hauled in by train. Special care was taken to cover the sand with gravel on account of the marked tendency of the former to blow away, especially where it has been disturbed, during the strong winds of the summer months. The plant, including storage yard, is 6,500 ft. long and 210 ft. wide. It has a long and narrow layout, as shown by Fig. 2, quite different from that of the plant at Louisville, Ky., described in *Engineering News-Record*, May 3, 1923, p. 782. The tie yard is of very exceptional shape, more than 3,000 ft. long but with a width of only about 180 ft. between the tracks on either side. It has a storage capacity of 50,000,000 ft. b.m. and both the yard and the treating plant are protected by fire mains, hose carts and alarms.

Hollow tile construction with a solid laminated roof built of 2x4-in. fir timber laid on edge is used for the building, 60x240 ft., which houses the retorts. The comparatively small difference in cost between this form of construction and that of a less permanent type is considered well justified in the elimination of fire hazard to the very valuable equipment, as well as in the economy obtained by reduction of radiation through the walls and roof. Four retorts 6 ft. in diameter and 117 ft. long are used in the treatment of the ties. These retorts, which are operated from one end, were moved from Wyeth, but provision was made in the dimensions and foundations of the building for future installations of larger retorts. Each retort has a capacity of fourteen tram cars and each charge consists of about 500 ties. The tram cars are handled by two 12-ton narrow gage gasoline locomotives.

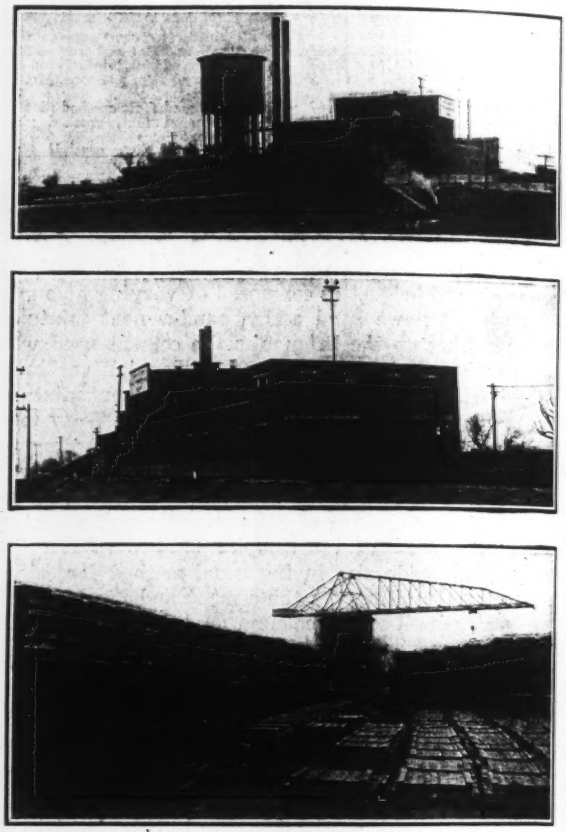


FIG. 1—TIE TREATING PLANT AT THE DALLES, ORE. Top: west end of retort house, with boiler house, tanks and coal incline. Middle: east end of retort house with charging doors and loading platform. Bottom: hammer-head crane in tie storage yard.

At one end of the retort room are two open working tanks, each of 50,000 gal. capacity. These are carried on towers at a sufficient elevation to permit of rapid gravity flow of solution to the retorts. The height of the building is increased over these tanks so as to enclose them, thereby reducing radiation. Four enclosed 6-ft. vertical pressure tanks, each of 5,200 gal. capacity, are used in connection with the treating process. Duplicate equipment of condensers, vacuum pumps and compressors has been provided. All these

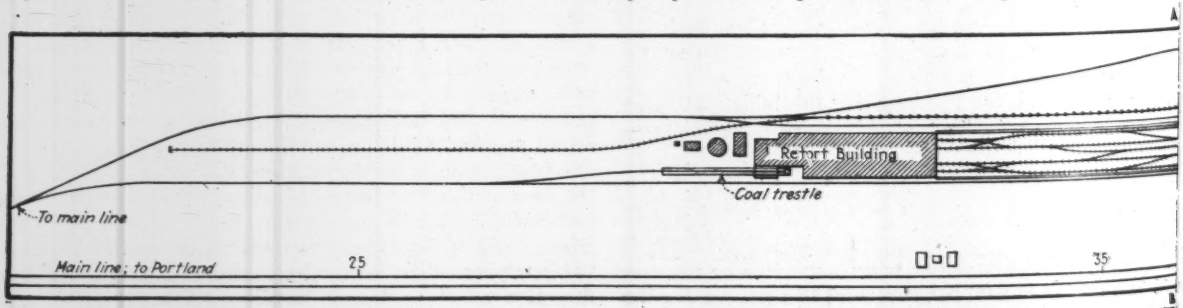


FIG. 2—LAYOUT PLAN OF TIE-TREATING PLANT.

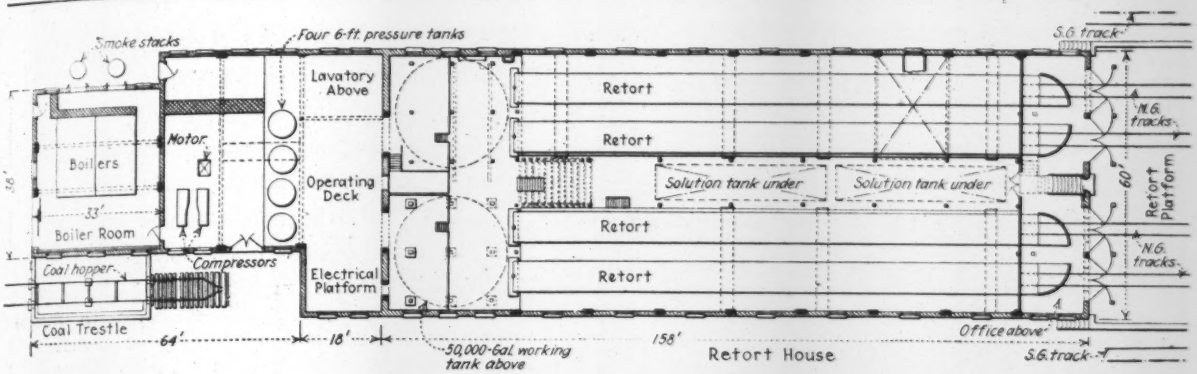


FIG. 4—PLAN OF RETORT HOUSE AND BOILER ROOM

units are interconnected among themselves and with the tanks and retorts, so that the greatest flexibility is afforded and it is practicable by means of valves to cut out any of the tanks or other facilities and to continue operation with minimum inconvenience. The heat necessary for steaming the timber and heating the solution is supplied by two 200-hp. water-tube boilers. As a result of careful study as to the extent to which electricity should be used in operating the equipment, the boilers are utilized solely for the purposes noted above, all pumps, compressors, vacuum pumps and other apparatus being operated by electricity.

There are two mixing tanks, each of 2,000 gal. capacity, and provided with gages by which the operators may readily determine the strength of the solution at any temperature. Gages on the working tanks enable the contents of each of these tanks to be determined very accurately. Similar gages are used in connection with the pressure tanks. In addition to these, recording gages connected with the retorts give a continuous record of pressure, temperature and vacuum. These various gages enable the operators to keep very close control of the process. The superintendent's office is located above the roof line of the retort house, thus affording a clear view of operations in the yard.

An electrically-operated hammer-head traveling crane with a hoisting capacity of 10,000 lb. on a radius of 90 ft. operates on a track of 20 ft. gage along the center of the narrow tie yard and is used in piling ties for storage and seasoning. This crane straddles a standard-gage railroad track provided with a third rail for retort cars or trams, so that it handles ties to and from the storage piles without interference to switching or other operations. The crane has a travel of 3,100 ft. on a maximum grade of 0.2 per cent. With a crew of three men it has piled 14,000 ties during eight hours but this performance is not the measure of its capacity, as it was limited by the supply of ties to be handled. The piles of ties are 21 ft. high but can be carried economically to a height of 28 ft. For treating, the

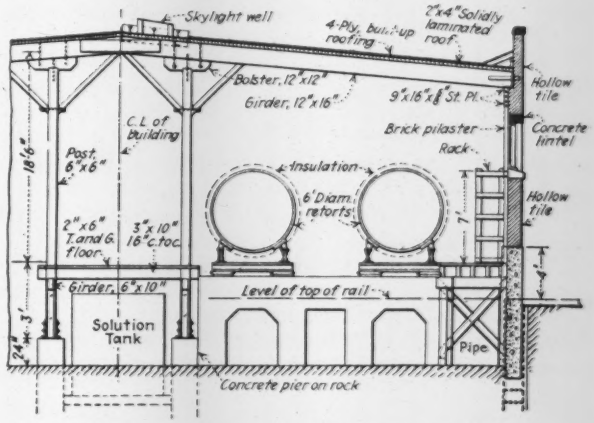
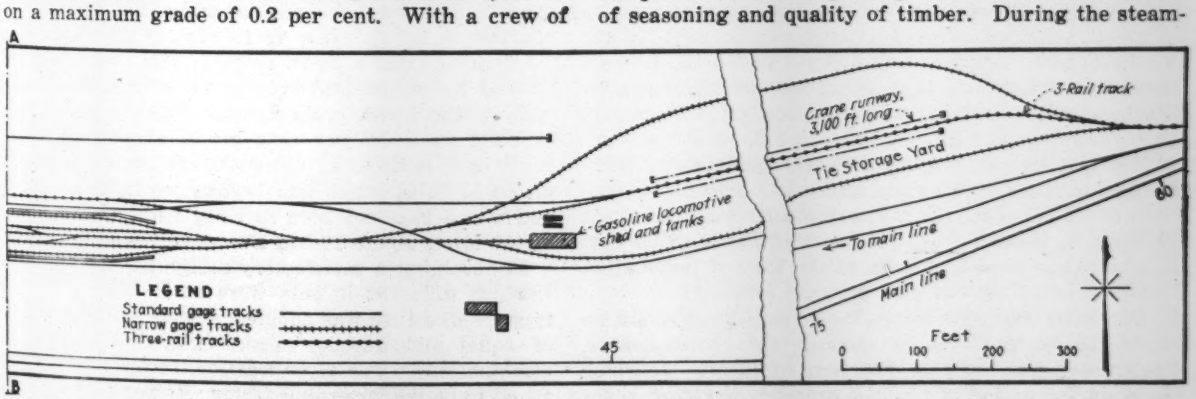


FIG. 3—CROSS-SECTION OF RETORT HOUSE

crane takes the ties from the seasoning piles and delivers them to the tram cars, trains of which are then pushed into the retorts by the gasoline locomotives.

While the plant may be used for either creosoting or burnettizing, the latter process has been used by the railroad company with good results for the last twenty years. The absorption of zinc-chloride aimed at is 0.4 lb. per cubic foot. Ties constitute practically all the timber treated. In the retort, the ties are first steamed, the period of steaming being varied to meet conditions of seasoning and quality of timber. During the steam-



OREGON-WASHINGTON R.R., AT THE DALLES, ORE.

ing the condensation and sap are drawn off through steam traps and discarded. When the steaming is completed, the vacuum pumps and condensers are put in operation and a vacuum of 20 in. is created in the retorts and pressure tanks and held for thirty minutes. At the end of this period, and while the vacuum is still being held, the valves from the working tanks are opened and the solution flows by gravity, assisted by the vacuum, into the retorts and pressure tanks. When a retort is full, the valve between it and the working tank is closed.

A pressure of 125 lb. is then applied to the pressure tank and is held until proper absorption is obtained, this amount being readily measured by the gages on the pressure tanks. Following the pressure period, the valve between the retort and the working tank is again opened and the compressed air above the solution in the pressure tank returns practically all of the solution in the retort to the working tank. Any of the solution remaining in the pipes, which might be lost during the steaming of the next charge, is drained into a sump and lifted by a small centrifugal pump into the working tanks or mixing tanks as may be desired. The foregoing processes having been completed, the ties are withdrawn from the retort and after cooling sufficiently to enable them to be handled are loaded into cars for shipment to various points. A large percentage of the ties are shipped in stock cars and box cars, although gondola cars are preferred when they are available. Car loading is performed by hand from a platform at car level.

This tie-treating plant has been in operation since June, 1923, and has proved exceedingly flexible and economical. It was designed and constructed under the direction of S. Murray, assistant chief engineer, Oregon-Washington Railroad & Navigation Co., and the expenditure involved was about $440,000.

High Head Reaction Wheel Runners Withstand Wear

TWO REACTION turbines in the Kern River No. 3 Power House of the Southern California Edison Co., which are rated at 25,000 hp. and operate under a head of 810 ft., were recently shut down so that rubber seal rings could be installed. In order that information could later be secured as to the wear and life of these seals an efficiency test was made just prior to the shutdown. This test showed that after 2½ years of operation the average efficiency loss of the two runners was 3½ per cent. Special interest attaches to efficiency reports on these units because they operate under the highest head thus far applied to reaction runners of large size. Features of the installation were described in *Engineering News-Record*, Sept. 15, 1921, p. 453.

The test on unit 1 using a 50-cycle runner and operating at a speed of 500 r.p.m. showed an efficiency reduction of 3¼ per cent. Unit 2, using a 60-cycle runner at 600 r.p.m. showed a 3¾ per cent efficiency reduction. Under the original test made at the time of installation both machines showed a 90 per cent efficiency.

The units are reported to be in very good condition hydraulically, the runners showing only normal wear, which is in fact less than the wear frequently occurring in a similar period of time in runners operating under much lower heads.

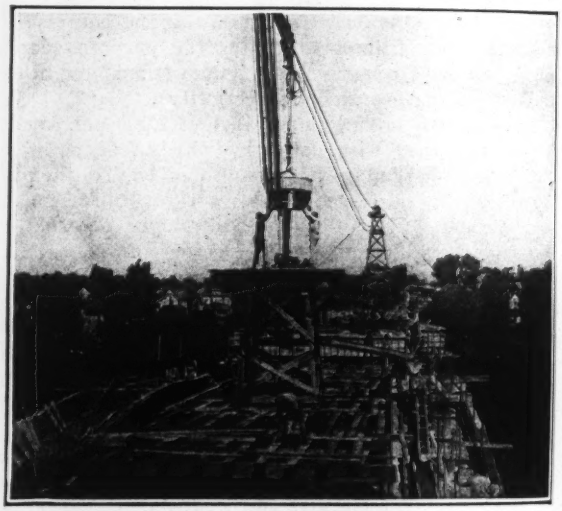
Six-Span Concrete Arch Highway Bridge at Danville

One of the First Large Municipal War Memorials Completed Now Subject of Study by Am.Soc.C.E. Committee

BY HARLAN H. EDWARDS
Formerly City Engineer, Danville, Ill., now Superintendent of Construction, Arthur G. Gehrig, Pasadena, Calif.

WITH THE double purpose of rebuilding the existing steel bridge at Gilbert St. with a more permanent structure and of erecting a structure of architectural beauty to serve as a fitting memorial to the fallen soldiers of the World War, the Victory Bridge over the Vermillion River at Danville, Ill., recently completed, forms the northern terminus of the Danville, Marshall and St. Louis highway. As this is one of the bridges under investigation by the American Society of Civil Engineers committee on concrete bridges, the following will be of interest.

The bridge is a 1,037-ft. reinforced-concrete structure, consisting of six arches and seven short approach



FIVE-POST BENTS PLACED AT EACH PANEL POINT

A 1,265-ft. cableway hung from 100-ft. towers with a rated carrying capacity of 4 tons removed the old steel bridge after dropping the members with dynamite and cutting with oxyacetylene torches. It distributed the concrete from a ½-yd. mixer plant at the south end by means of 1½-yd. bottom-dump buckets to a portable bin, thence to the forms.

spans. The longest arch is about 195 ft. and the shortest is 107 ft. It is 75 ft. high at the river, while its deck contains a 30-ft. roadway and two 7-ft. walks flanked by ornamental reinforced-concrete open handrails of the Greek cross design. The entire structure is built on a 0.7 per cent grade, sloping up to the south, and replaces an old steel deck-truss bridge completed in 1895, which had become too light for traffic, and which also had been so badly neglected that some of the lower members had almost rusted away.

In obtaining a satisfactory design for the structure, thirteen different layouts were made before the final type of structure was adopted. These included the use of equal and unequal spans, of almost all possible combinations. The river location, however, was finally found to be the governing factor. It was very desirable that one pier be placed at the south edge of the river, and

WEDGE BLOCKING AND BRACING AT PANEL POINTS
A 6 x 12-in. cap over wedges covered a wedge block so that 2 x 12-in. joists could be laid on it without framing.

that another replace the old stone pier on the north side, thus using but one cofferdam both to remove the old pier and to construct the new one. The river span was therefore determined, and it was a simple matter, then, to select and design the proper spans on each side. The architectural features were made as simple as possible with due regard to the beauty and utility of the structure, with octagonal columns and shapes predominating.

Foundation—The excavation for the foundation of the new structure was carried down through clay and gravel until solid shale was reached. The shale was cleaned off and excavated to a minimum depth of 1 ft. to secure a proper foundation. Borings were made to determine the extent and nature of the underlying shale, which was found to be solid for many feet below. In sinking piers 3 and 4, just north of the river, 6-in. Wakefield sheetpiling was used, being driven about 18 ft. through coarse gravel and some sand to a solid footing in shale. Little trouble was found in keeping the pits free from water, although a considerable quantity was found in the pier directly north of the river.

In pouring the concrete in the rings, the location of the construction joints was determined on two conditions. The first and paramount condition was that the deflection in the centering should be kept as uniform as possible and at a minimum, while the second was that the last concrete poured should be at a point of splicing of the reinforcing steel. Concrete was therefore placed in the center three panels of the ring first, leaving a construction joint at each end and also just above the springing. These construction joints were perpendicular to the neutral axis of the arch rings and were provided with a key usually about one-half of the depth of the ring and a foot less than the width.

The memorial feature of the bridge is not located directly on the structure, but rather a short distance away on the north approach. As decided upon by a committee of the local post of the American Legion, the memorial is to consist of a 27-ft. monument by Lorado Taft, set in a grassed oval, flanked on each side by a 240-ft. roadway, uniting in a 40-ft. drive extending to the bridge.

The bridge was built under an interesting cost-plus form of contract, with the designing engineer retained by the city to have complete supervision of the construction. The base cost of the structure was set and agreed upon as $265,000. The contractor's fee was 5 per cent of the actual cost of the structure if it should be equal to the base cost. If, however, through good planning, the cost should be reduced, the contractor would receive 5 per cent of the actual cost plus

SIX-SPAN CONCRETE MEMORIAL BRIDGE, DANVILLE

40 per cent of the saving as his reward. Should the cost exceed the base cost, however, the contractor's fee of 5 per cent would be reduced by 20 per cent of the excess, with a minimum fee provided of $11,500. It is seen that under normal conditions, there was a double incentive to save money on the job and a penalty for waste.

In the wind-up of the job the contractor got the minimum fee plus a lump sum rental fee of $17,500 for equipment agreed upon beforehand. The total net cost of the bridge to the city, not including paving or backfill of approaches, was about $310,000. Paving and ap-

proach work, electrical work and landscaping cost about $50,000 and the Victory Monument, by Lorado Taft, another $50,000.

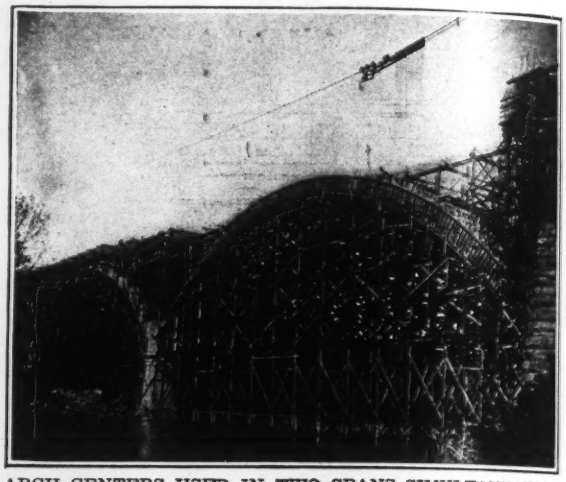
Arch Centering—Arch centers of the bridge were of timber construction, made up of five post bents located at each floorbeam or panel point. The 8x8-in. posts were braced transversely and longitudinally with 3x8-in. timbers. Two posts were paced under each arch ring and capped with a 10x12, upon which were placed five sets of pine wedges. A 6x12-in. cap on top of the wedges carried a wedge block shaped so that 2x12-in. joists could be laid directly on it without framing, except for squaring the ends. Posts of 8x8-in. sticks were extended upward from the arch ring caps and were, with the center post of the bent, capped by 10x10-in. timbers to carry the floorbeams and roadway slab forms. Mud blocks were proportioned for a pressure of one ton per square foot, which proved ample.

In locating the arch rings, an ingenious method was used, adapted for this work by W. E. Reynolds, assistant engineer for the designing engineers. It consisted of the use of a templet for the exact location of the bottom of the arch rings. In placing it, a 2x6 was spiked vertically to the end of the cap of each bent. A vertical mark, placed thereon by instrument from stakes previously placed in adjacent fields, located the exact panel point. A horizontal mark was then placed intersecting the vertical mark from levels established along the line of the structure. The intersection of these two lines determined the exact

TEMPLET ON POSTS OUTLINES ARCH RING

location of the bottom of the ring at each panel point. Templets which had previously been made were then spiked to these 2x6-in. pieces at each panel point, thus outlining the entire bottom of the arch ring. By this means any variation was immediately detected by eye and corrected. All further work on the rings was done by leveling from this templet. It was simple to make, easy to put up and served its purpose well.

In establishing the points for the bottom of the ring due allowance was made for settlement at each joint and of the mud blocks; also for the deflection of the arch ring after pouring. Further settlement was provided to be taken up through wedge blocking. The ends of the arch joists were cut square, and wedges were driven between them to make the ring forms firm and solid from pier to pier. Side forms for the rings were not cut to the exact length, but were rather cut to



ARCH CENTERS USED IN TWO SPANS SIMULTANEOUSLY
Forms, at sawmill and shop next the lumber yards, were brought in by cableway, saving time, labor and scaffolding.

a uniform length to admit of repeated use on the other rings of the structure.

The contractors for this bridge were Yeager and Sons, of Danville. The bridge was designed by Harrington, Howard & Ash, consulting engineers, represented in the field by W. E. Reynolds, assistant engineer, assisted by S. G. Gould, resident engineer. Owing to the nature of the contract, it was felt desirable to have the consulting services extend to cover all phases and details of the construction and a review and approval of all purchases. The entire work on the bridge and its approaches was under the general direction of the writer.

Progress on Providence Water Supply

THE new water supply project for Providence, R. I., is now entering on its most active construction stage. It is hoped that contracts for the remaining essential parts of the work will be let during the present season, and that water from the new source will be available either in the spring or summer of 1926 or early in 1927 dependent upon rainfall and runoff and that practically all the construction will be completed early in 1927. A description of the work in its early stages appeared in *Engineering News-Record*, May 3, 1917, p. 233. The contract for the main dam and dike of the Scituate reservoir, which controls the time for completion of the project, was awarded to Winston & Co. Inc., in May, 1921, at about $3,500,000. This work has progressed most satisfactorily in compliance with the time requirements. The contract for the tunnel portion of the Scituate aqueduct, about 3½ miles in length and equivalent in area after lining to a 93-in. circle, was awarded in September, 1922, to the Keystone State Construction Co. for $1,318,000. This work is also progressing satisfactorily, a total length of over two miles of tunnel having been excavated. Bids for the first half of a filtration plant to have an ultimate capacity of 100 m.g.d. and for adjacent portions of the Scituate aqueduct were to be received May 21. B. Thomas Potter is chairman and Samuel N. Grammont is secretary. F. E. Winsor is chief engineer, with William W. Peabody deputy chief, and Francis B. Marsh designing engineer. J. Waldo Smith and Allen Hazen, New York City, are the consulting engineers. Plans for the purification works were prepared by Hazen & Whipple.

Manufacture of Pipe for Spavinaw Water Project

Fifty-Three Miles of Reinforced-Concrete Pipe Made in Field Factory in 13½ Months—Operation Rate at 97 per Cent Capacity Was 1.3 Miles per Week

PLANT LAYOUT was the main time factor in the field manufacturing plant for the longest reinforced-concrete conduit yet built—53 miles of 60- and 54-in. pipe for the Spavinaw Water Supply Project for Tulsa, Okla. Co-ordination of the different units, provision for the accessories, such as welding, galvanizing, and gasket making, shops and livable housing quarters, was effected to make a smooth working field factory which operated at 97 per cent capacity and completed the job a month ahead of schedule. March 15 saw the last length cast. The 147,747 ft. of 60-in. and 129,800 ft. of 54-in. pipe, representing a value of $3,000,000 as it lay in the yard, was made in 13½ months, beginning with nothing on the 40 acres of raw, level prairie land at Verdigris, a village of tank-town dimensions on the Frisco railroad.

Since computations indicated 1,152 ft. or 96 12-ft. lengths of pipe must be made per day, two complete units were laid out for 60-in. and two more for the 54-in. pipe. Although interconnected, they were operated independently with separate gangs.

Each unit consisted of stock piles for the stone and sand, cement bins under which were the mixing plants; the gantry track on each side of which were 36 base rings upon which the steel forms were set and the pipe poured; the curing racks with capacity of 576 lengths per unit; one gantry crane; and a railroad spur track for loading the pipe from the racks to the trains. For each unit one boiler furnished the steam for curing the pipes. The total storage capacity on the racks or skids was 28,000 ft. of pipe. A complete railroad system was constructed to handle materials and shift pipe in the yard, one locomotive and one locomotive crane being used in this work. One crawler tread crane was used to handle the sand and stone.

On the sketch of the plant layout (Fig. 1) is shown the location of the steel yards. This whole area, 200 x 525 ft., was floored with 1-in. boards, a precaution which proved of great value during the unusually wet season in which the pipe was made. Just north of the steel yards was the engine-room, the general machine shop, the blacksmith, and the joint ring, welding, and galvanizing shops. The plant was operated and lighted by an engine-driven motor-generator set; steam was

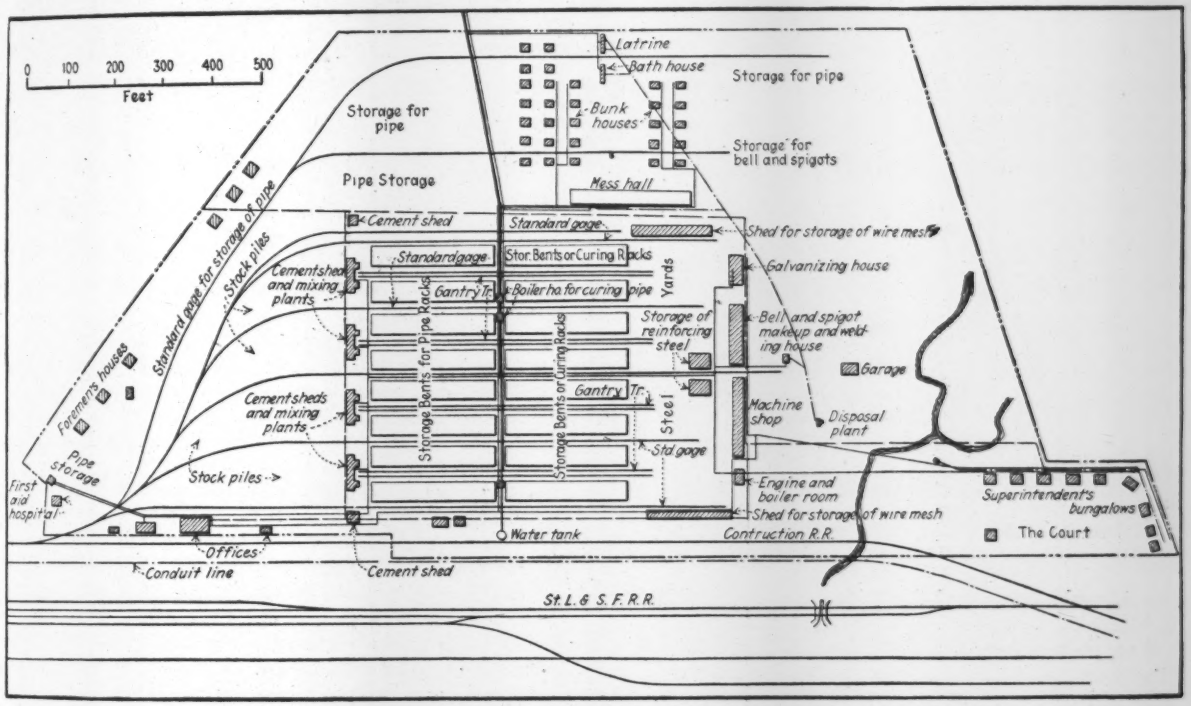


FIG. 1—MANUFACTURING PLANT FOR MAKING CONCRETE PIPE AT VERDIGRIS

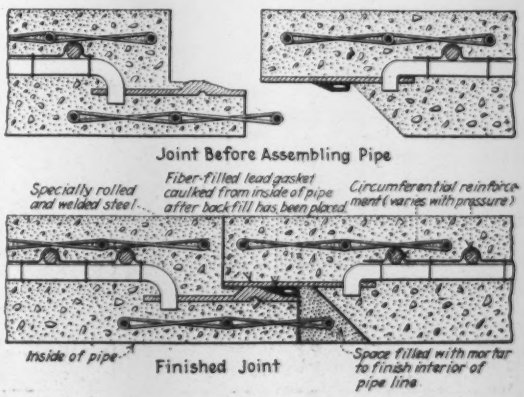

Joint Before Assembling Pipe
Specially rolled and welded steel
Fiber-filled lead gasket caulked from inside of pipe after back fill has been placed
Circumferential reinforcement (varies with pressure)
Inside of pipe
Finished Joint
Space filled with mortar to finish interior of pipe line

FIG. 2—LEAD AND STEEL PIPE JOINT BEFORE AND AFTER BEING PULLED TOGETHER

furnished by three 40-hp. boilers. North of the shops, on a little hill overlooking the plant, was "The Court" about which were grouped the bungalows where the superintendents and manager lived in comfortable, modern four-room houses. West of the steel yard were located the commissary, which fed 300 men at a meal, and the bunk houses, each of which accommodated eight men. A complete water system, with softening and purification plant, and a sewerage system were installed. The source of water supply was the Verdigris River, two miles distant.

Stone used for the concrete was ¼- to 1-in. limestone, obtained from Garnett, only 6 miles away. The sand was Arkansas River sand, shipped from Tulsa, 20 miles to the west. Cement was obtained from two Oklahoma plants within a radius of 60 miles.

The reinforcing steel consisted of triangular mesh and deformed bars. All pipes had a double cage of reinforcement, the inner cage in all cases consisting

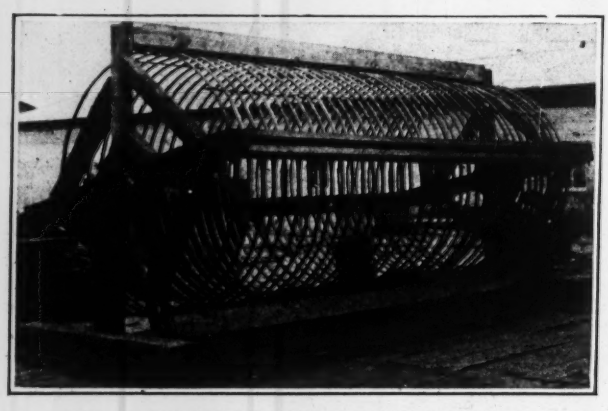


FIG. 4—FRAME FOR ASSEMBLY OF STEEL FOR OUTSIDE CAGES

of triangular mesh and the outer cage either of triangular mesh or of welded steel bars, according to the internal pressure. In each end of the pipe a galvanized-steel ring was molded for the purpose of forming the joint. The bell end was made of steel ¼ in. thick and 6 in. wide, and the spigot consisted of a special section, the main body of which was ⅜ in. thick, but with a raised portion which caused a wedge-shaped cavity to be formed on the interior of the pipe when laid, into which a fibre-filled gasket was calked. The joints are made

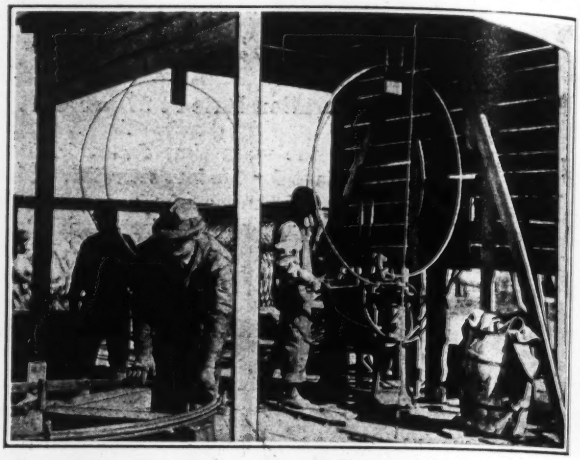


FIG. 5—ELECTRIC WELDING DONE IN THE OPEN
Speed attained by hanging bands on arms of suspended cross.

of this fibre-filled gasket, which was cut to exact size and soldered together, making an endless ring. The joint rings were received flat, were cut to exact size, and the ends welded together by means of an electric arc, after which they were cleaned, pickled and galvanized. An idea of the accuracy of this work is obtained when it is stated that the clearance between the inside of the bell and the outside of the spigot on a 60-in. pipe is only $\frac{1}{16}$ in.

These joint rings were tied to each other by means of 12 ½-in. longitudinals in the 54- and 14 in the 60-in. pipe. The allowable unit stresses in the reinforcing steel varied according to the heads on the pipe. For the lower heads, 12,000 lb. per square inch was used, and for the higher heads, 10,000 lb., all stress being carried by the steel. The heads on this project vary from 20 to 135 ft. with an average slightly less than 60 ft.; the water flows from Spavinaw Lake to Mohawk reservoir entirely by gravity.

All mesh cages were lapped and tied; all bar cages were made up of steel hoops. These cages were formed in special mandrels, giving the exact spacing for the bars (see Fig. 4). The circumferential bars were electrically welded and tests made on this welding proved them to be as strong as the original bar. Special clips, manufactured on the job, were used to fasten the circumferential steel to the longitudinal bars. In the

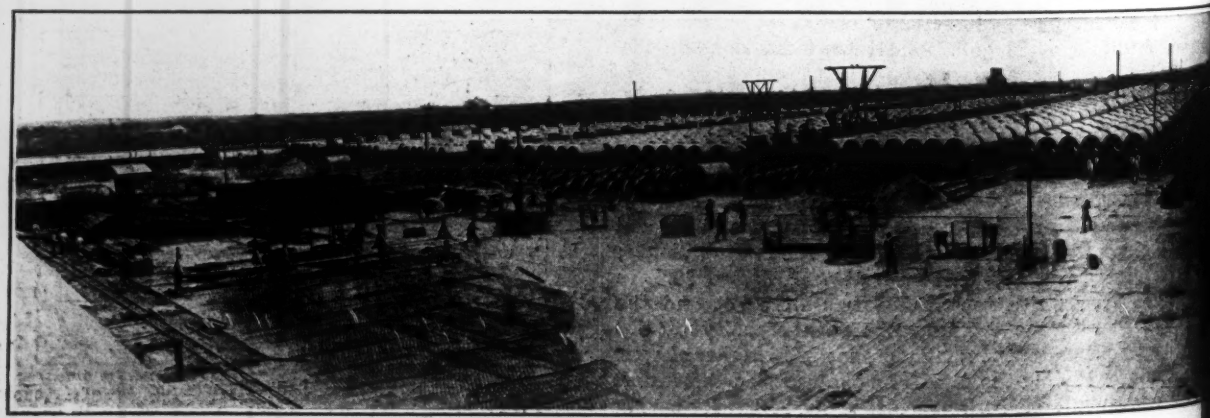


FIG. 3—FORTY-ACRE REINFORCED-CONCRETE PI
Planked steel yard in foreground where the cages were fabricated on mandrels. Gantry cranes

FIG. 6—PICKLING AND GALVANIZING JOINT RINGS

manufacture of these cages only one shift was employed, working from 7:30 a.m. to 4 p.m., during which time enough cages were made for the next day's set-up.

The schedule called for the setting of 24 forms per day per unit, or a total of 96 forms. The forms within which this pipe was molded consisted of steel cylinders of ⅜-in. plate, carefully assembled to accurate dimensions. When set for pouring, the inner and outer forms rested upon finished cast-iron base rings. The forms were so designed that the inner could be contracted and the outer expanded until they could be lifted clear of the comparatively green concrete without injuring it. The forms were always carefully cleaned and oiled before each pouring. Especial care had to be taken to keep the inside of the pipes to a high degree of smoothness in order that the coefficient of friction should be kept as low as possible, for there was only a small head available for this 53 miles of line—0.347 ft. per 1,000 ft. on the 54-in. portion, and 0.19 ft. per 1,000 ft. on the 60-in. The entire plant was brilliantly lighted by electricity since two shifts were employed, the first working from 4 a.m. to 12:30 p.m. and the second from 12:30 to 9 p.m. The first shift removed the canvas covers from the previous day's pouring, stripped the forms and replaced the covers. Both the inner and outer forms were thoroughly cleaned and oiled; the inner was placed on the base ring and the outer set between the base rings to be placed after the reinforcing was set on the rings. The forms, the reinforcement cages and the concrete were handled by the gantry, always for two pipes at a time, one on each side of the crane. As shown in Fig. 1, the track for the crane extended into the steel yard, where the crane picked up the inner cage, carried it to the base ring and set it over the inner form already in place. Care was taken to maintain a uniform space between the two of about 1 in. After this cage was brushed with a wire brush to remove all foreign material, the outer cage was placed on the ring, spaced about 1 in. from the outer form. This cage was carefully readjusted, rebraced and cleaned. At this point the reinforcing was carefully checked and inspected by the superintendent and the engineers, and note was made by each of these as to the kind and amount or reinforcing, thus designating each length as a special class of pipe. After the outer steel form had been lifted and placed on the ring, the tamping platform was placed on top. This platform received the concrete when poured, and also served to space the inside and outside form and the spigot joint ring, holding all rigidly in the proper position during the setting of the concrete.

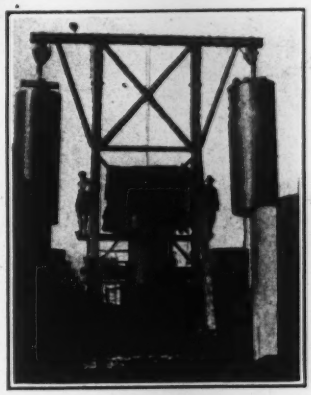


FIG. 7—GANTRY TRANSFERS INSIDE FORMS

The second shift poured the pipe for the day, tipped and stored the pipe poured the third day before.

The aggregate storage area, just southwest of the mixers and between the railroad spurs, was covered with 1-in. boards in order to insure clean materials. It was necessary to run the crawler-tread crane three shifts a day in order to handle the material from the

UFACTURING PLANT AT VERDIGRIS, OKLAHOMA
te in steel forms. Storage racks practically full. Reinforcing-steel storage at left and end bands at right.

cars to the stock piles. Wheelbarrows with special measuring gates were used to carry the aggregate to the mixers. All cement was stored in the building above the mixers and delivered directly into them by canvas chutes. Every care was taken to secure a uniform mix. The concrete was 1:1½:2 mix but the cement mortar used at the bell-and-spigot end of the pipe was 1:1 mix. About 75,000 cu.yd. of concrete was used, requiring 185,000 bbl. of cement. Details of mixing in the small tilting-type electrically-driven mixers, conveying it by the conical bottom-dump buckets by the gantry crane to the forms, special tamping and subsequent steam curing within a canvas cover, were similar to the methods heretofore used by the contractor at Denver (*Engineering News-Record*, Sept. 16, 1920, p. 553) and Kansas City (*Engineering News-Record*, Dec. 22, 1921, p. 1029).

On the evening of the third day the pipe was tipped and placed on the storage or curing racks by the gantry crane by means of a steel band on one side of the pipe

FIG. 8—WIPING OFF RINGS AFTER IMMERSION IN SPELTER

With two vats of sulphuric acid, one of hydrochloric, one for water and two for spelter, 480 rings have been put through per day but the normal run was 192 rings.

and a chain which passed on the other side. A concrete block weighing four tons was the counterweight when the 7-ton length of pipe was lifted. The cast-iron base was tapped off. By means of pulleys and various devices, and taking advantage of the center of gravity of the pipe, which had previously been marked with a red line upon each joint, the pipe was tipped from a vertical to a horizontal position, lowered onto skids, and rolled onto the storage racks. These racks were of such a height that the pipe would roll from them upon the standard-gage flat cars, which were run between the racks of each unit. These cars were made up into trains, which operated on the Spavinaw Railroad. Ten locomotives and 100 flat cars were in use in distributing the pipe along the line of the ditch.

Due to unusually heavy rains, the sudden runoff in this territory and the consequent sudden rise in the rivers, two of the largest railroad bridges were lost. This congested the storage of the pipe but work in the yards was delayed only a few days.

Credit for the record, the excellent organization and efficient planning is due to J. C. Mitchell, general manager, and W. E. Corbett, construction manager of the Lock Joint Pipe Co., the manufacturers of the pipe. The Spavinaw project is under the administration of the Board of Water Commissioners of Oklahoma City. The engineers who designed the project and made the surveys are J. D. Trammell, of Fort Worth, Tex., and W. R. Holway, of the Holway Engineering Co., of Tulsa. Mr. Holway has been the chief engineer since the letting of contracts. Dabney H. Maury, of Chicago, is the consulting engineer.

Business Principles Enunciated by U. S. Chamber of Commerce

Ethical Procedure Adopted at Annual Convention Given as Ideal Basis for Intercourse Between Members and Public

ALONG with voluminous reports on commercial, industrial and business relationships, both national and international, and the adoption of resolutions urging specific action concerning the many problems before it, the Chamber of Commerce of the United States, meeting during the week of May 5 at Cleveland in annual convention, enunciated a set of business principles calculated to induce ideal commercial relationships both among members of the chamber and between members and the public. All delegates to the convention by unanimous vote subscribed to the code at the closing session on May 8. The principles were contained in the report of the special committee on business ethics, of which Judge Edwin B. Parker, umpire, Mixed Claims Commission, Washington, is chairman.

Asserting that "the function of business is to provide for the material needs of mankind, and to increase the wealth of the world and the value and happiness of life," the chamber pronounced the following principles: Explanatory paragraphs following each principle (in italics) are the comment of the ethics committee.

1—*The foundation of business is confidence, which springs from integrity, fair dealing, efficient service, and mutual benefit.*

2—*The reward of business for service rendered is a fair profit plus a safe reserve commensurate with the risks involved and foresight exercised.*

The policy of charging the public "all the traffic will bear," if in excess of a reasonable profit, is unsound in principle, and while in isolated and unusual cases it may bring temporary prosperity, cannot last, for sooner or later an outraged public will take measures to prevent it. The effort should rather be to seek as low a price as possible to enable the producers to realize cost, plus a safe reserve, and a fair profit, taking into consideration all elements of foresight exercised and risk involved. Efficient management and foresight are entitled to reasonable rewards. The risks in business enterprises are diverse for investors, managers and employees. Losses flowing from such risks must be borne, not by the public but by the business taking them, which in turn is entitled to be compensated for the risks taken.

3—*Equitable consideration is due in business alike to capital, management, employees and the public.*

Every business enterprise necessarily utilizes capital, management, the service of employees, and deals with the public. It, therefore, has obligations to capital, management, employees and the public. No business enterprise is entitled to survive, much less to prosper, without discharging its obligations to each of these classes, and enlightened self-interest should prompt each class to deal fairly with all others, because to do so ultimately pays.

4—*Knowledge — thorough and specific — and unceasing study of the facts and courses affecting a business enterprise, are essential to a lasting individual success and to efficient service to the public.*

No business enterprise can be safely conducted in its own or the public interest on guesses or inaccurate information. Knowledge is essential. It will fall short in the duty which it owes to itself and to the public if it does not constantly improve the service it renders in quantity, quality and in costs. While it should be prepared to take advantage of every opportunity to reduce the costs of its service without sacrifice to those interested in the industry, it must on the other hand have such accurate knowledge of its costs that it can know whether or not it is receiving a proper return for its service. . . .

5—*Permanency and continuity of service are basic aims of business, that knowledge gained may be fully utilized, confidence established and efficiency increased.*

All transactions for gain do not attain to the dignity of a business enterprise. . . . If the end sought is . . . immediate gain, . . . they are merely speculative and constitute no part of the business fabric of the community.

6—*Obligations to itself and society prompt business unceasingly to strive toward continuity of operation, bettering conditions of employment, and increasing the efficiency and opportunities of individual employees.*

The obligation to employees is not discharged merely through the payment of wages as they become due. Whether in office or in plant, labor of every class—inventive, managerial, and manual—should be so employed that each individual has every opportunity that the business and his position make possible to increase his ability to serve and the value of the service he renders to himself, to the business, and to the public through the business. The employer is not only interested in problems of employment but, whether he so will or not, he is interested in problems of unemployment. Not only in the public interest, but in his own interest, he must, in order to create and preserve a permanent organization, and avoid the blighting effects of labor turnovers, provide in some form, as continuous employment as the needs of the economic field will permit.

7—*Contracts and undertakings, written or oral, are to be performed in letter and in spirit. Changed conditions do not justify their cancellation without mutual consent.*

Business enterprises are so closely interwoven and interdependent that the ignoring of the obligations of one frequently has far-reaching effect on others. . . . No obligations should be undertaken without careful consideration, and when undertaken should be faithfully performed.

8—*Representation of goods and service should be truthfully made and scrupulously fulfilled.*

9—*Waste in any form—of capital, labor, services, materials, or natural resources — is intolerable, and constant effort will be made toward its elimination.*

10—*Excesses of every nature—inflation of credit, over-expansion, over-buying, over-stimulation of sales — which create artificial conditions and produce crises and depressions, are condemned.*

In the last analysis, every business enterprise is directly or remotely related to all others. . . . Therefore, each business should study the conditions of the entire economic field in which it operates and be so conducted as not to contribute to the inflation of credit, to the accumulation of unnecessary stocks of materials, or to other factors which result in business crises and periods of depression with wide-spread loss and suffering. These consequences are produced as the cumulative result of great numbers of errors of like kind—errors of over-expansion, over-buying, over-commitment—resulting in excessive demands on credit and artificial shortages in material and transportation.

11—*Unfair competition, embracing all acts characterized by bad faith, deception, fraud, or oppression, including commercial bribery, is wasteful, despicable, and a public wrong. Business will rely for success on the excellence of its own service.*

Every business enterprise should deserve and command success because of the excellence of its own products and service, rather than because of the shortcomings or misfortunes of its competitors. . . . The seeking of a business advantage through efforts directed to harm a competitor is unethical and wasteful. . . . Whatever form such efforts may take, whether misrepresentation of wares, defamation of credit, enticement of employees, commercial bribery to secure competitive business, the use of financial strength to drive competitors from the market or any action of any nature whatsoever opposed to good morals because characterized by bad faith, deception, fraud, or oppression, entails waste and is repugnant to the public interest.

12—*Controversies will, where possible, be adjusted by voluntary agreement or impartial arbitration.*

War is in its nature essentially destructive. Peace is constructive. The weapon of war is force. The instrument of peace is agreement. The issue of discord and strife in business is economic waste. Therefore sound business policy requires the speedy and amicable settlement of all controversies between employer and employees, between buyer and seller, between producer and consumer, and among all persons whomsoever. Failing in this, recourse, where practicable, should be speedily had to some form of business arbitration. The course will be resorted to only for the determination of important and unsettled questions of law raised in good faith. Under no circumstances is litigation justifiable for the purpose of delay only.

13—*Corporate forms do not absolve from or alter the moral obligations of individuals. Responsibility will be as courageously discharged by those acting in representative capacities as when acting for themselves.*

It has been abundantly demonstrated that the corporate form of organization makes for efficiency, the elimination of waste, increase in production, and in the reduction of unit costs. . . . Individual responsibility, however, is not lost through corporate action but on the contrary is increased in exactly the ratio that the influence exerted through corporation action exceeds that of independent individual action. . . . Moral responsibility for the management of a business in the form of a corporation is exactly the same as that of the same business owned and managed by an individual. The managers and directors of corporations must be big enough and strong enough, and courageous enough to discharge their delegated responsibilities and act for the corporate entity just as they would act on their own behalf. Enlightened self-interest will prompt the great body of stockholders to delegate responsibilities only to men of this type.

14—*Lawful co-operation among business men and in useful business organizations in support of these principles of business conduct is commended.*

. . . No creed or code can or should be static. The complexion of an act changes when its application to changing conditions brings a changed result. Therefore, what is ethically and economically sound today may be unethical and illegal a generation hence, due to the evolutionary development of our civilization and the relations of industry, commerce and trade generally, to society. While the principles of business conduct put forward for the consideration of this chamber have been designed in the main to lay down general principles which theoretically should be static, the members of the chamber and business men everywhere must keep in sympathetic touch with changing conditions, economic and otherwise, and be ever ready to enlarge and modify these principles if and when required. . . .

15 — *Business should render restrictive legislation unnecessary through so conducting itself as to deserve and inspire public confidence.*

The growth and development of business, and the progress and well-being of society as a whole, demand unhampered opportunity for individual effort and initiative which is rendered increasingly difficult in proportion to the increase in government regulation of business. On the other hand, methods and practices designed to secure immediate gains, without reference to their effect on the general public or their ultimate effect on the business itself, sometimes render imperative restrictive and regulatory legislation in the public interest. Business impatiently resents such legislation. The remedy lies in its own hands. It can, if it will, be governed and regulated by its own rules and principles of business conduct enforced by the most effective of all sanctions—a wholesome public opinion—created and fostered by business itself. . . .

India Building World's Greatest Irrigation Project

Masonry Dam 1 Mile Long—Many Miles of Large Canals—Unusually Heavy Rainfall in Catchment Area

Special Correspondence

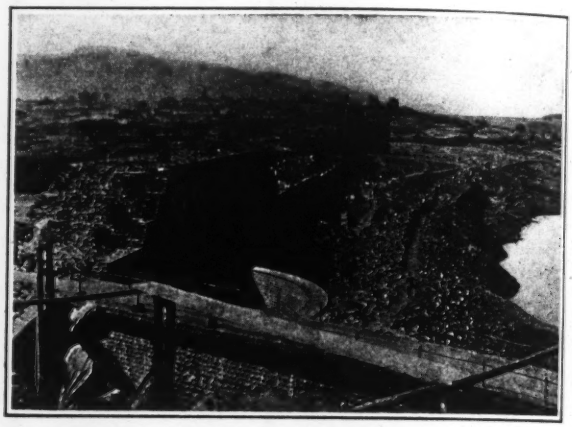
IN ORDER to enlarge the irrigation works on the Indus River in the Province of Sind in India, the government started last October to build a new dam known as the Lloyd dam or the Sukkur Barrage at Bhatghar, 35 miles from Poona. When the work is completed in 1927 it will be the largest irrigation project in the world, providing water for the irrigation of 6,000,000 acres of land, at a total cost, including the dam and canals, of about $50,000,000.

The dam or barrage across the Indus River will be over 1 mile long and will have 66 arched openings of 60 ft. each provided with control gates. The dam is being constructed of a local limestone. It will have two bridges on the top; the lower one directly over the water openings will have a roadway, and the other one will be used for the machinery operating the gates. The height of the dam above the lowest foundation will be 185 ft. and the height of the water above the sills of the lowest sluices will be 143 ft. This height can be increased to 153 ft. by means of gates in the waste weir. The masonry content of the dam will be approximately 800,000 cu.yd. In comparison with the Assuan dam on the Nile, in Egypt, the Lloyd dam falls short of reaching the dimensions of that structure, which has a length of 6,200 ft. and a masonry content of about 900,000 cu.yd. The storage capacity of the Lloyd dam will be 551,000 acre-ft. as against 1,070,000 acre-ft., stored by the Assuan dam.

WORKMEN ON TOP OF THE SUKKUR BARRAGE
Electric stone hoist shown in the center; finished dam in distant left center; old dam on the left.

Before the construction of the new dam was started the possibility of using the old dam was considered, but it was found that the gain in yardage would be offset by the cost of excavating around the old structure for new foundations, by the extra length (the new dam as now constructed being shorter than the old one), and the difficulty of cutting extra sluices with the old dam under pressure and of making a homogeneous structure out of the old and new work.

Two-thirds of the work on the new dam has now been done and it is anticipated that the whole structure will be completed by 1927. At first glance this seems slow according to American standards, but there are various factors which control the speed which are not obvious. One is the supply of money. The project was originally financed from yearly state revenues and the allotment of funds was uncertain. This has, however, now been arranged. The speed of construction is dependent also



PARTLY COMPLETED SUKKUR BARRAGE
Old dam in foreground, also circular staunches for the passage of the new structure through the old dam. Men are working in the temporary waste weir.

on the supply of labor and materials, especially lime, which has to be quarried and burned at some distance from the work and carted to the site. It is interesting to note that the country bullock cart, when it can be obtained, is more economical than mechanical traction which is also available and used to supplement the carts. Finally, as the dam is built with an excellent but slow-setting grade of natural hydraulic lime, it is not desirable to build too great a mass of masonry in any one working season of eight months. During the monsoon no work is possible owing to the drenching rain and the fact that much unskilled labor returns to agriculture.

Power for the project is supplied by a hydro-electric plant operating with water from the old lake.

The work was designed and has been executed until recently by C. B. Pooley, of the Public Works Department of India, who recently left Bhatghar on promotion. The work is let out to Indian contractors who are entirely unskilled as engineers and merely provide the labor and materials and lay masonry as directed by the departmental engineering staff.

Irrigation Canals—Immediately above the dam large canals will be taken off. The eastern or Nara Canal will be carried through a deep cut nearly double the width of the Suez Canal, to a distant section of the country in the Nara River valley. The northwestern canal will be nearly 100 miles long and will have about 500 branches. This canal will be nearly as wide as the Suez Canal and will irrigate more than 750,000 acres. The Central Rice Canal, which is the second largest, will be half as wide again as the Suez Canal and its discharge will be equal to that of the River Thames. It will be 87 miles long and will have 350 miles of branches. In all, there will be 850 miles of main canals and over 1,200 miles of branches.

Engineering Literature

A MONTHLY REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

Water Bacteriology Brought to Date

REVIEWED BY SIR ALEXANDER HOUSTON

Director of Water Examinations, Metropolitan Water Board, London, England

ELEMENTS OF WATER BACTERIOLOGY with Special Reference to Sanitary Water Analysis—By Samuel Cate Prescott, Professor of Industrial Microbiology in the Massachusetts Institute of Technology, and Charles-Edward Amory Winslow, Professor of Health in the Yale School of Medicine. Fourth Edition, Rewritten. New York: John Wiley & Sons. London: Chapman & Hall. Cloth; 6 x 9 in.; pp. 211. $2.25. 11½s.

The reviewer congratulates the authors on their great achievement in producing this book, a copy of which no sanitarian can afford to be without.

Bacteria in natural waters are first dealt with and the relation between time of storage and self-purification is concisely and ably considered. A chapter on quantitative bacteriological examination of water makes excellent reading, the hints given on sampling, icing, plating, composition of media, incubation, counting and expression of results showing that the authors are masters of the subject. The following discussion on the interpretations of the quantitative bacteriological examination involves many questions open to controversy but the subject is dealt with in an equitable manner. One is pleased to note that the authors fully realize that percentage reduction may sometimes be misleading and that with a really good pre-filtration water a 99 per cent removal may be practically impossible. In the chapter on the relation between counts made at 20 and 37 deg. C. one is glad to find the prominence given to the great value of the latter.

The colon group of bacilli is considered at great length. It is wisely pointed out that too much reliance must not be placed on the presumptive test. This is especially true when dextrose instead of lactose broth is used. American investigators have been a little tardy in their recognition of the extreme value of bile-salt media as introduced by MacConkey in 1900. Before the war these media were extraordinarily useful but nowadays all the brands the writer of this review has tried have been found to be only relatively satisfactory. The chapter on the significance of the presence of the colon group in water is an important contribution to a most difficult problem. Few will quarrel with the following:

(1) Bacteria corresponding in every way to B. Coli (as ordinarily defined) are by no means confined to animal intestines, but are widely distributed in nature. (2) The finding of a few colon bacilli in large samples of water, or its occasional discovery in small samples, does not necessarily have any special significance. (3) The detection of B. Coli in a large proportion of small samples (1 c.c. or less) examined is imperatively required as an indication of *recent* sewage pollution. (4) The *number* of colon bacilli in water rather than their *presence* should be used as a criterion of recent sewage pollution.

Altogether the evidence is quite conclusive that the absence of B Coli demonstrates the harmlessness of a water so far as bacteriology can prove it. That when present its number is a reasonably close index of the amount of pollution appears to be proved beyond reasonable cavil. It may be safely said that when the colon bacillus is found in such abundance as to be isolated in a large proportion of cases from 1 c.c. of water it is generally proof of the presence of serious pollution.

The authors deal with the significance of streptococci in a manner deserving of all praise. It is an extraordinarily difficult subject and the writer of this review, who may justly claim to have been the original advocate of this test, has always been prone to admit that it suffers from many limitations. In considering the significance of the anaerobes in water analysis the authors take a bold line when they say "the chief interest of the water bacteriologist in these spore forms is due to their interference with the presumptive test"—nevertheless many workers will heave a sigh of relief when they read these inspiriting words.

The description of the methods of isolating the typhoid bacillus from water makes dismal reading but the reasons are not far to seek and are known to all experienced bacteriologists. The authors are not very happy in their references to the isolation of the anthrax bacillus from water. Methods which do not involve the animal as a sifting medium are practically hopeless.

The significance and applicability of the bacteriological examination are carefully reviewed. Naturally, the chemical analysis of water suffers in comparison with the bacterial. Nevertheless, the reviewer could cite many instances where the chemical examination has revealed points of supreme importance and that long before the bacterial results were available for reference.

The chapters on the bateriology of sewage and sewage effluents and on the bacterial examination of shellfish hardly come up to the standard of the other sections of the book.

The general excellence of the contents of the volume has already been mentioned. In mechanical makeup the volume is, like nearly all American productions, a credit to its publishers. The printing is beautifully clear and the paper of excellent quality.

Making Damp Walls Dry

DAMP WALLS: A Handbook on the Various Causes of Dampness in House Walls and the Best Methods for Architects, Builders, Surveyors and Property Owners in dealing with this troublesome Defect; With a chapter on Condensation and Notes on Waterproof Building Construction—By Ernest G. Blake, M.R.S.I., A.B.I.C.C., Medallist in Sanitary Building Construction; Author of "Building Repairs." New York: D. Van Nostrand Co. Cloth; 5 x 8 in.; pp. 248; 68 halftones and line cuts. $3.

There is no minor engineering problem more difficult of solution than to make a damp wall dry. There are all sorts of expedients and a few cures, but invariably either expedient or cure will prove more complicated than the amateur at waterproofing estimates. Probably no text can tell how the particular problem can be solved; that is too often a matter of after-the-fact knowledge. But a text can list the various methods that have proved successful in a variety of cases and the reader can at least have the advantage of knowing the many methods even though he is not sure which to apply. The book noted comes in that category; it is an excellent compilation of methods that have proved successful in British practice. Except for too frequent reference to British patented schemes, unknown in this country, it should be useful to American engineers.

Contractors' Accounting

PRACTICAL ACCOUNTING AND COST KEEPING FOR CONTRACTORS: Illustrating and Describing in Easy, Understandable Language, Bookkeeping and Accounting Systems for Contractors, Giving Complete Instructions and Examples of the Proper Methods of Keeping Time and Compiling Costs on all Classes of Construction Work—By Frank R. Walker,, Affil. Am. Soc. C. E., Author of The Building Estimator's Book. Chicago: Frank R. Walker Co. Cloth; 9 x 12 in.; pp. 169; 245 reproductions of forms. $2.50.

Contractors are accused of being lax in their accounting methods. Compared with other lines of business, contracting deserves perhaps some degree of censure for the manner in which it records or does not record the fiscal side of its operations but conditions in this respect are improving generally and many contractors do very thorough accounting. It is a fact, however, that many contractors need to do better bookkeeping and much better cost keeping. The book whose title is given above will help them in their task whether they adopt its forms as they stand or use them merely as guides in devising other systems.

There are 15 chapters in the book, one on proposals and contracts and one on preparing estimates, two long chapters on costs and cost keeping and the remaining half score, with an introductory chapter, on bookkeeping and accounting procedure. Each chapter contains a set of accounting forms with text explaining their purpose and how to use them. The author has had in mind chiefly the business of building contracting. The general contractor must, therefore, search about more than he would like to find the parts applying to other kinds of construction, but there are many of them which can be found. The book contains simple systems of accounting for the small jobbing contractor as well as more complete systems for the general contractor conducting large operations and many of them.

An earlier book on the same general subject entitled Practical Accounting for General Contractors, by H. D. Grant, was noticed in these columns Aug. 17, 1922, p. 285.

Hydraulic Power Outlets and Control

REPORT OF HYDRAULIC POWER COMMITTEE, 1924, Technical National Section, Including Report on Control and Outlet Works—Prepared by the National Electric Light Association jointly with the Pacific Coast Electrical Association. New York: National Electric Light Association. Paper, 8 x 11 in.; pp. 146; 140 halftones and charts and diagrams. 85c.; 55c. to members.

The greater part of this unusually valuable report deals with control and outlet work for diversion dams and storage reservoirs. It contains many valuable data on the design, construction and operation of such structures throughout the United States and Canada, thus adding much to the data on similar works given in the Bureau of Reclamation report on High-Pressure Reservoir Outlets reviewed in *Engineering News-Record*, Dec. 20, 1923, p. 1026. Detailed descriptions and many diagrams of typical installations are included. The report also includes the practice of most of the member companies operating hydraulic plants throughout the United States and Canada, giving much information that is not available in any other form.

The section on pitting of hydraulic turbine runners contains valuable data from operating companies and gives their experience with various kinds of runners operating under heads varying from a few feet up to several hundred feet, and with various draft heads. This information has been tabulated and certain conclusions have been stated. The section also deals with methods of effecting repairs.

The present status of draft-tube development is dealt with in a short resumé of recent developments, and tests of draft tubes and suggestions for future research work are included. The subcommittee on lubricating method presents a short constructive criticism of present methods, and the subcommittee on methods of inspection and maintenance also presents a short report giving several methods of keeping reports. The two recent developments in waterwheel testing, that is, the Gibson method and the salt-velocity method, are briefly described and the questions of waterwheel rating and efficiency guarantees are dealt with. Another subcommittee presents a short report on types of runners for varying heads. The report closes with a statement from the manufacturers relative to developments in the hydraulic field in the year 1923 with descriptions of various installations of note and illustrations of turbines, scroll cases, and draft tubes.

Appendix A to the report is a paper by S. Logan Kerr on the fall in pressure in hydraulic turbine penstocks due to acceleration of flow. This paper deals with the dangers of a rapid fall in pressure in penstocks due to the sudden opening of the valves, a subject which has not received the same attention as that of the rise in pressure due to a sudden closing of the valves. The paper gives examples of the use of the theory in determining the amount of time necessary to open large valves setting up dangerous stresses in penstocks. An abridged bibliography of hydro-electric subjects treated in American and foreign periodicals since Jan. 1, 1923, is bound in with the report.

Country Roads and City Streets

THE CONSTRUCTION OF ROADS AND PAVEMENTS—By Thomas Radford Agg, C.E., Professor of Highway Engineering, Iowa State College. Third Edition, Revised and Enlarged. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6 x 9 in.; pp. 519; 109 halftones and linecuts. $4.

Few books of the many which have been written have provided a balanced discussion of highways including both city streets and country roads. It was the merit of Professor Agg's original manual, published eight years ago, that it then did this. It is supremely the merit of the enlarged revised edition now published that it does this today when the ramifications of the highway engineer's functions are many more and their interrelation is far more complex. Beginning with the highway as a social force the author considers it as a problem in public finance, as a problem in economic location, as a task of engineering design and construction, as a working structure to be kept up and renewed and as a duplex system of rural and urban thoroughfares. Necessarily the treatment has had to be concise.

There are other books which give the reader more of some one phase of highway engineering—more of road types and materials, of location, design and construction, of financing and economics, of upkeep and reconstruction or of city pavements as a special problem—but none so well combines all these factors in a single volume. This gives the book, designed to be a textbook primarily, a real appeal to the trained road engineer. It helps him to get into the field of his vision at one time all of his tasks.

Specifically the book has 21 chapters and is without those abominable nuisances—appendices—into which, generally, in engineering books, is thrown the information which the author has thought to be too much labor to epitomize in his main text. Ten chapters discuss each

one type of road—as earth, gravel, or concrete—covering materials, design, structure and construction. Four preceding chapters consider system development, surveys and plans, drainage and design. Two chapters, in many respects the most interesting of the whole score, present an economic comparison of roadway surfaces and deal with the selection of roadway surface types. In these chapters the author summarizes much of his own research work in highway and highway traffic economics. There is one chapter specifically on city pavement, one on dust layers, one on maintenance and one on testing road materials. There are a glossary and an index.

A Further Volume of Hool and Kinne

REVIEWED BY CHARLES A. MEAD

Chief Engineer, Division of Bridges and Grade Crossings, New Jersey Board of Public Utility Commissioners, Upper Montclair, N. J.

STEEL AND TIMBER STRUCTURES—Compiled by a Staff of Specialists; Editors-in-Chief: George A. Hool, S.B., Consulting Engineer, Professor of Structural Engineering, University of Wisconsin; and W. S. Kinne, B.S., Professor of Structural Engineering, University of Wisconsin. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6 x 10 in.; pp. 605; many diagrams, charts and halftones. $6.

When a work claims to cover thoroughly the design and construction of the principal types of modern civil engineering structures and to give such a complete treatment of the elementary theory that it may be used for home study, a college textbook or a book of reference, a standard has been set upon a very high plane. The current volume is of a series of six by Hool and Kinne. It is complete in itself. On this diversified subject about which so much has appeared, it is to be expected that a new volume will contain much that is already old. In its manner of presentation it should take on a new light and in that feature should lie its chief claim to individuality and prominence. The fact of necessary repetition does not detract from the value of the book but rather enhances it because the necessity for reference to other volumes is thereby minimized.

Much useful material appears in the chapter on buildings, which points out the essentials of good design and makes handy, well arranged references to the building requirements of various cities. To this chapter is appended a comprehensive glossary of building terms. Roof trusses, bridges of steel and timber, trestles, chimneys, details, fabrication, erection, estimating and materials have been treated in as great length as the restricted size of the volume will permit. It is refreshing to note that chimney design is taken up in connection with other matters of building design. Usually one has to turn to some volume on mechanics for these data.

The insertion of chapters on short-span steel and timber bridges is justified under the title of the volume even though it deals so largely with buildings. Bridges of a higher order are to be treated in another volume. The brief section on highway bridges could well have been expanded to include examples of the best modern practice for heavy loading. The chapters on detailing, fabrication and erection are especially important because they play such a vital part in design. Shop tools and methods of erection are described for the purpose of making known their possibilities and limitations. A comprehensive statement of the principles of the fabrication and erection of structural steel and machinery concludes these chapters.

In the collection of brief sections comprising the volume, much practical material is given in form for handy reference which ordinarily would require time-consuming search. This alone is sufficient to justify the position of the book in a working engineering library, while the list of prominent contributors assures its authority.

Economists on Cement Prices

PORTLAND CEMENT PRICES: Their Basis, Character and Present Position—By Henry Parker Willis, Professor of Banking, Columbia University, Formerly Consulting Economist, Federal Reserve Board; and John R. B. Byers, Instructor in Economics, College of the City of New York. New York: The Ronald Press Co. Cloth; 5 x 8 in.; pp. 23; 16 diagrams and many price tables. $1.25.

The two authors of this book, respectively, are a professor of banking at Columbia and an instructor in economics at the College of the City of New York. The investigation on which the book was based was undertaken at the request and in behalf of some leading producers of portland cement in the eastern district of the United States, and these producers threw open their books to the authors, but the opinions submitted are the independent and authoritative conclusions of the professional economists. These conclusions are that, insofar as eastern cement goes, the price of portland cement is not unreasonable judged either by (1) prices for other commodities of like sort; (2) the general level of prices for all commodities; (3) earnings or dividends when studied in the light of general fiscal data; or (4) utility or value as obtained by the consumer and as indicated by his use of the product.

The analysis is the one made familiar in the suits brought by the government against the cement trade associations. The economic argument is that a standardized product of widespread manufacture and general use is bound to assume a uniform price regardless of cost of production, but the authors also prove by federal income tax figures that the producing companies are not making undue profits and by statistical records that the price of cement has had fluctuations quite comparable to those for any commodity.

The evidence is convincing to all except those who are firmly persuaded by some inner consciousness that cement is too high. In view of such figures as Professors Willis and Byers cite, it would seem that the proponents of the excessive charge theory ought to submit at least equally authentic figures on their side of the case.

PUBLICATIONS RECEIVED

WIDE RANGING INFORMATION of much interest is given in a 96-p. illustrated pamphlet, Facts and Figures of the Automobile Industry, 1924 edition (National Automobile Chamber of Commerce, 366 Madison Ave., New York City). Among the striking exhibits in the pamphlet is one showing by table and diagram the relative increase in registered motor vehicles and in telephones since 1902. Starting with 28,755 motor vehicles and 2,371,044 telephones in 1902 the relative numbers gradually then rapidly approached each other until for 1923 motor vehicles were but slightly fewer than telephones, the numbers being 15,092,000 against 15,370,000.

ONCE MORE THE AIR-LIFT PUMP has been taken in hand, this time at the Engineering Experiment Station of the University of Wisconsin. The results have been set forth in a 166-p. illustrated pamphlet (Madison, Wis.; 75c.) by Clayton Norman Ward, assistant professor of hydraulic engineering, assisted by Lewis H. Kessler, instructor in hydraulic engineering. The pamphlet is entitled Experimental Study of Air-Lift Pump and Application of Results to Design. The work reviewed "was started in 1919 when the problem arose of selecting footpieces for air-lift pumps

which were to be installed in certain wells belonging to the state of Wisconsin." Later on the investigation was continued, making use of "eduction pipe of greater diameter and of greater length" than those used in the previous tests, the later apparatus being set up in the hydraulic laboratory of the University of Wisconsin. The studies were carried on under the direction of Professor Ward by a group of seven students as thesis work, one of these students being Mr. Kessler.

A VARIETY OF INFORMATION AND OPINION on the pollution of navigable waters by oil from ships and other sources, and also on the pollution of inland waters by various means is presented in the Transactions of the National Coast Anti-Pollution League, covering the second annual meeting of that organization held at Atlantic City in October, 1923 (F. H. Phinney, secretary, American Mechanics Building, Trenton, N. J.; $2).

THE ARIZONA AGRICULTURAL EXPERIMENT STATION has published an illustrated bulletin of 37 pp. and some folding sheets of tables on the Design and Construction of Small Concrete-Lined Canals, by W. E. Code, assistant irrigation engineer (Tuscon, Ariz.).

CIVIL ENGINEERING AS A CAREER, a short paper by W. K. Hatt, professor of civil engineering, Purdue University, has been printed by the National Research Council (Washington, D. C.).

AMONG THE TROUBLESOME INDUSTRIAL WASTES are those from creameries. A 39-p. bulletin entitled Aeration Studies on Creamery Waste Purification, by Max Levine, Lulu Soppeland, and E. W. Burke, has been issued by the Engineering Experiment Station of Iowa State College (Ames, Iowa; free on request).

AMONG THE PAPERS in Volume 4 (1923) of Contributions from the Anna M. R. Lauder Department of Public Health, Yale University School of Medicine (New Haven, Conn.) are: Comparative Efficiency of the Circular Konimeter and the Palmer Water Spray Apparatus for the Determination of the Dust Content of Air, C-E. A. Winslow and Robert Jordan; Amebic Dysentery in Connecticut, Francis G. Blake and Ira V. Hiscock; Recruiting of Sanitarians for the Service of the State, C-E. A. Winslow; Laboratory Control of Water Supplies and Sewage Treatment in the Large Cities of the United States in 1920, Ira V. Hiscock.

A METROPOLITAN TRANSIT SYSTEM for New York and Its Environs is the subject of a 69-p. report entitled Suburban Transit Problems, by Daniel L. Turner, consulting engineer of the Transit Commission, State of New York (49 Lafayette St., New York City). Maps and plans, some of which are on folding sheets, show the number of trains entering city terminals, the relation of New York City to other areas in the metropolitan district, existing suburban roads, and proposed transit system, distribution of population, etc. An abstract of the report appeared in *Engineering News-Record*, May 8, p. 818. The population of the metropolitan district was 8,587,000 according to the census of 1920. The area of the district considered is nearly 3,800 sq.mi., or more than that of the States of Delaware and Rhode Island combined.

IRRIGATION IN THE MADRAS PRESIDENCY for the year 1922-23 is reviewed in Part II of the Administration Report of the Public Works Department of Madras for the year indicated. Text and tables together fill 222 foolscap pages. The price of the report in India is R.s. 1-12-0. It may be obtained from various London publishers including Constable & Co. P. Hawkins, M.Inst.C.E., of Madras, is joint secretary to the government.

CENTRAL ELECTRIC STATIONS IN CANADA summarizes in 30 pp. figures on that subject collected as a part of the Canadian Census of Industry, 1922. A feature of the report is the number of stations and corresponding horsepower of stations using water wheels and turbines, steam engines, steam turbines, gas and oil engines. The report was prepared in collaboration by the Dominion Census and Water Power Branch, Department of the Interior, with the assistance of the following Provincial Commissions: Ontario Hydro-Electric, Quebec Streams, New Brunswick Electric Power, Nova Scotia Power and Manitoba Power. Column heads and stubs of tables are given in both English and French. (Ottawa, Ont.: Dominion Bureau of Statistics.)

IN MOSQUITO AND MALARIA CONTROL, a 41-p. illustrated pamphlet written by Lorra G. Lenert, sanitary engineer in charge of Mosquito Control Work, California State Board of Health (Sacramento, Calif.), the subject indicated is reviewed with special reference to California conditions. The striking tailpiece of the pamphlet is reproduced herewith

Malaria Is Carried Solely by Anopheles Mosquitoes.

New Books and Revised Editions

[Those desiring copies of the books listed below or mentioned elsewhere in this section should order them from the publishers or from their local booksellers.]

ESTIMATING BUILDING COSTS AND APPRAISING BUILDINGS—By Frank E. Barnes, C.E., Supervising Building Valuation Engineer of New York Central Lines. New York and London: McGraw-Hill Book Co., Inc. Leather; 5 x 7 in.; pp. 822; many charts and other line drawings, halftones, and data tables. $5.

LOW TEMPERATURE CARBONIZATION—By C. H. Lander, D.Sc., M. I. Mech. E., A. M. Inst. C. E., Director of Fuel Research under Department of Scientific and Industrial Research, and R. F. McKay, M.Sc., M. I. Mech. E., A. M. Inst. C. E. London: Ernest Benn, Ltd. Cloth; 7 x 10 in.; pp. 277; 33 line drawings and halftones. 35s. net.

Objects, problems, methods and products of low-temperature carbonization of coal reviewed.

MAKING LETTERS TALK BUSINESS: Covering Points of Vital Importance to the Correspondent and the Stenographer in the Development of Teamwork to the End that Their Letters May Become More Resultful—Prepared by Sherman Perry, Correspondence Department, The American Rolling Mill Co. Middletown, Ohio: The American Rolling Mill Co. Cloth; 6 x 9 in.; pp. 84. $1.25.

OIL ENGINES—By A. L. Bird, M.A., Assoc. M. Inst. C. E. New York: E. P. Dutton & Co. Cloth; 6 x 9 in.; pp. 281; 143 diagrams. $5.

A British book, designed primarily, the Preface states, "for students of engineering who have already gained some familiarity with motive-power machinery in general" but "it is thought that it may also be of assistance to the numerous trained engineers who are changing over to this branch, whilst it would be a source of gratification to the author to think that those already expert may find something of interest."

PRACTICAL CALCULUS FOR HOME STUDY—By Claude Irwin Palmer, Associate Professor of Mathematics, Armour Institute of Technology. New York and London: McGraw-Hill Book Co., Inc. Flexible; 5 x 8 in.; pp. 443; 186 line drawings; tables of formulas, trigonometric tables; answers to exercises. $3.

PROBLEMS OF PUBLIC FINANCE—By Jens P. Jensen, Department of Economics, University of Kansas. [Crowell's Social Science Series.] New York: Thomas Y. Crowell Co. Cloth; 6 x 8 in.; pp. 606; $3 net (postage extra).

STRENGTH OF MATERIALS—By James E. Boyd, M.S., Professor of Mechanics, Ohio State University. Third Edition, Revised. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6 x 9 in.; pp. 430; 253 diagrams and halftones. $3.50.

This edition includes the following changes, according to the Preface: "The application of the method of Area Moments has been simplified, the equation for the deflection of a column has been derived by elementary calculus, and slight modifications have been made in the text of many articles. The greater portion of the problems have been rewritten." The first edition was noticed at length by L. E. Moore in *Engineering News*, March 14, 1912, p. 506.

THE TECHNICAL ORGANIZATION: Its Development and Administration—By John Morris Weiss and Charles Raymond Downs. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6 x 9 in.; pp. 197. $2.50.

Designed primarily for workers in chemical laboratories and chemical plants. Takes up personnel; laboratory buildings and routine work therein; notebooks, records, reports and files; sampling, etc.; fire and other safety matters; cost and profit accounting.

THE TECHNIQUE OF EXECUTIVE CONTROL—By Erwin Haskell Schell, Assistant Professor of Business Management, Massachusetts Institute of Technology. New York and London: McGraw-Hill Book Co., Inc. Cloth; 5 x 8 in.; pp. 133. $1.75.

The Preface states that this book "is intended as a manual or guide to executive straight thinking."

DIE THEORIE ELASTISCHER GEWEBE UND IHRE ANWENDUNG AUF DIE BERECHNUNG BIEGSAMER PLATTEN, Unter Besonderer Berücksichtigung der Trägerlosen Pilzdecken—Von Dr.-Ing. H. Marcus, Direktor der Huta, Hoch- und Tiefbau-Aktiengesellschaft, Breslau. Berlin: Julius Springer. Paper; 6 x 9 in.; pp. 368; 123 line cuts. $5.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

A Half Century of Land Surveying

Sir—I have read with much pleasure the anniversary number of your half century of *Engineering News-Record*.

Mr. Frost commenced its publication at about the time I commenced the practice of land surveying. And my attention being called to the then *Engineer and Surveyor* I subscribed for it and as the subject matter for the first two or three years dealt largely with surveying practice, in which its columns became an open forum for discussion of disputed points in the practice of that day, myself with others received great help from the legal phases of the discussion. I also recall that Mr. Frost published in 1878 a compilation of land laws and legal decisions rendered by the courts of several states, that was helpful in many ways.

It would almost seem that a short résumé of the practice of land surveying might well have been included in your anniversary number. Since 1874 fully one-half of the public lands of the United States have been sectionized, and the contract system then in force has been replaced by a trained corps of salaried land surveyors in the employ of the federal land department, fitted out with the best and latest instruments, insuring accuracy not required under the contract system. Other departments of the federal government have completed precise surveys of several meridian and parallel arcs, that have given us a better knowledge of the size and figure of the earth than we possessed fifty years ago.

Engineering News-Record is to be commended as a live factor in the scientific and industrial progress of the day and its publishers are to be congratulated on the high standards you are maintaining in its management.

As a matter illustrating progress in the methods of drainage I send a photo showing how it was done in 1863.

Glenwood, Iowa, May 2, 1924. SETH DEAN.

Continuous Pavement Lengths

Sir—In the issue of April 3, 1924, you give a table showing continuous length of pavements composed wholly of concrete, which table omits the Montauk Highway in Suffolk County, on the south shore of Long Island. This highway is paved with cement concrete from the Nassau County line at Amityville easterly to the west corporation line of Southampton village, affording the automobilist a continuous trip of 62.28 miles of concrete pavement. This road may be the longest stretch of pavement of one type in any single county in the United States.

Patchogue, N. Y. HERMAN BOETTJER,
April 7, 1924. Assistant Engineer, Suffolk County.

Low Bridge-Painting Costs

Sir—In your issue of May 1, p. 772, F. G. Schworm of Philadelphia has a valuable article full of detailed information on bridge cleaning and painting, a subject on which accurate data are rare or at least seldom published. It seems to me that the cost was low. The price paid for labor was low for city work.

It may be interesting to compare these figures with the following prices per ton for cleaning and two-coat painting a steel highway bridge about a mile long, as given by the successful bidder, an experienced bridge painter. The bridge was not badly rusted:

Operation	Price per Ton
Cleaning	$0.25
Paint	1.75
Application	1.00
Brushes	.10
Insurance	.10
Expenses	.10
Overhead	.16
Profit	.34
	$3.80

The paint was red-lead, $4 per gallon for one coat and $3 per gallon for the other coat. The second coat, which was the $3 paint, was colored black with chinese blue and lampblack, which take more oil than red-lead and reduce the cost. The 10c. for expenses was railway fares. It was a good job by professional bridge painters. The $4 paint weighed 28 lb. per gallon, net.

This leads me to express the opinion that the prices Mr. Schworm paid for paint per gallon were too low. The average cost of linseed oil in 1923 in car lots was $1.06; red-lead, dry (not painters' red-lead but all sorts of medium and low grades), 10.9c. per pound; chrome green (commercial but unadulterated), 30c. per pound. What I would call a rather low-grade red-lead paint would cost $2.80 per gallon for materials, with plenty of extras for cartage, containers and mixing; and would not be as cheap per square foot as a much better quality which would spread better. A red-lead paint at $2.25 per gallon must be adulterated, and probably is unprofitable to buy; and a green paint at 12c. above the carload price of oil ought to be pretty poor stuff.

It is also to be observed that a man applied 1.3 to 1.5 gals. per day. To do this it was probably necessary to use a brush about a half wider than the New York law allows (4½ in.) and creates a suspicion that the paint was largely benzine, which would make it flow more easily. The total cost of the paint was a little more than one-seventh the whole cost of the job; and, as the total expenditure was to get this paint in place, perhaps it would have been economy to have paid a little more for the paint.

There should have been three coats rather than two. Three coats on unpainted metal is certainly the standard practice among American bridge engineers; the third doubles the life of the other two.

Two coats (perhaps only one sometimes) may be enough for repainting where the old paint is good; but not on a clean, sandblasted surface. Never.

New York, May 5. A. H. SABIN,
Consulting Chemist, National Lead Co.

CUTTING DRAINAGE DITCHES IN WESTERN IOWA IN 1863

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

News Brevities

A 5,000-hp. Hydro-Electric Plant on the Androscoggin River, a few miles north of Berlin, N. H., is proposed by the Dummer Power Co., Concord, N. H.

Four Thousand Trucks and 1,000 War Department tractors will be distributed to the states for use in highway construction if the bill which has just been recommended by the Military Affairs Committee of the Senate becomes a law.

Much Testimony Has Been Taken by the rivers and harbors committee of the House in the matter of diversion of water from the Great Lakes at Chicago. No new facts have been developed and there is no prospect of legislation.

A Dam 100 Ft. High on the North Fork of the Kentucky River, near Airedale, Ky., to develop 20.000 hp., is proposed by W. J. Loughbridge, of Lexington, Ky., who has filed a declaration of intention to build with the Federal Power Commission.

The Caraway Bill directing the Federal Power Commission to extend the permit of the Dixie Power Co. for a hydro-electric power site on the White River in Arkansas has been approved by the president. Under the provisions of the Federal Power Act this permit would have expired on March 3. This is the first time the Federal Power Act has been modified in a specific case.

The State of Illinois is Pressing the Federal Power Commission for a decision on its license to develop power at the mouth of the Fox River. The property rights at the site are held by Fred D. Breit, who is to build the project, subject to its recapture by the state at the endof twenty years. It is understood that the contract for the work will be let to J. O. Heyworth.

The Washington Irrigation & Development Company is urging the Federal Power Commission to expedite the report which the district engineer of the War Department at Seattle is making on the Priest Rapids site. The company holds a preliminary permit for the development of power at this site and is anxious to secure its license in order to proceed with the preparation of its construction plans.

Early Action on the Development of water power at the Pelton site on the Deschutes River is expected following the report the geological condition of the site made by the engineering staff of the U. S. Geological Survey at the request of the Federal Power Commission. The geological formation as regards foundations was one of the uncertain factors in connection with the proposed development of this site by the Columbia Valley Power Co.

Los Angeles Approves Flood and Water System Bonds

At the election May 6 in Los Angeles bond issues were authorized totaling $46,900,000 including $35,300,000 for county flood control, $8,000,000 for extending the city's water distribution system, $1,600,000 police bonds, $400,000 for fire boats, $1,000,000 for bridge repairs and $600,000 for rubbish incinerators. A $21,000,000 municipal power bond plan failed by a few votes of getting the necessary two-thirds majority. The flood-control measure, which received a majority of more than 70 per cent, provides for twelve storage dams in the foothills, including the San Gabriel canyon storage project that involves a $20,000,000 dam about 575 ft. high forming a 280,000 acre-ft. reservoir.

Roof Falls in Baltimore Tunnel

A 15 x 30-ft. section of the inner ring of brick in the roof of the Pennsylvania R.R. tunnel at Baltimore fell on May 9, interrupting traffic on both tracks for several hours. Traffic on the south bound track was resumed as soon as the roof at the point of damage was trestled, 9 hours after the fall.

According to A. C. Shand, chief engineer, Pennsylvania R.R., the accident happened under North Ave., where there is only 12 ft. of cover over the roof of the tunnel, and at a low point in the street, the street grade rising in both directions. A few days before the accident a 36-in. water main above the tunnel broke at a point about 100 ft. away. The inner ring of brick, which was not bonded to the second ring, was loosened by the flow of water into the tunnel and fell. The remainder of the brick ring was not damaged to any great extent, except for a deflection downward immediately over the northbound track. The only portion of the tunnel affected was one construction section, about 75 ft. long. This has been uncovered since the accident and the arch will be rebuilt.

Federal Ship Plant Has Fire

Fire destroyed the largest building of the Federal Ship-Building Co., located on the Hackensack River near Newark Bay, N. J., during the night of May 18. The building, a two story steel and frame structure, was valued at $500,000 and the contents at a similar amount. The explosion of fourteen acetylene tanks located throughout the plant for use in cutting plates, materially aided the rapid spread of the fire.

Power Companies Agreeable To U. S. Shoals Operation

General Manager of Alabama Co. So Testifies Before Senate Agriculture Committee

Washington Correspondence

Power companies of the southeast which have submitted a bid for the government's hydro-electric and chemical plants at Muscle Shoals would be entirely satisfied with government operation of the project and would offer to buy power from the government to be distributed through their interconnected lines, E. A. Yates, general manager of the Alabama Power Co., testified before the Senate committee on agriculture.

In "some respects," Mr. Yates said, answering a question by Senator Kendrick, government operation of the hydro-electric development would be preferable to private operation.

The Alabama Power Co. would be willing to sell the land it owns at the site for proposed dam No. 2, Mr. Yates said, at a fair figure if the government desired to build this dam. He called attention to the fact that the company had sold land necessary for dam No. 2 at $1 during the war. Answering the statement that Muscle Shoals was neglected after the war until Henry Ford made his offer for the properties, Mr. Yates declared that the Alabama Power Co. had written the Secretary of War in 1921 offering to co-operate with the government in both hydro-electric and chemical work at the project.

Hydro Development Possibilities

Mr. Yates told the committee that the growth of power consumption in the southeast is so rapid that, with increased farm utilization of electricity and expected partial electrification of railroads, the possibilities of the section for hydro-electric development would be exhausted and there would be a shortage which would have to be met by steam generation within 15 years. Other witnesses explained the power companies' offer to manufacture fertilizer.

The power companies' offer to pay $10,000,000 a year for a lease on dam No. 2, for 50 years under the Federal Water Power Act; to purchase outright the steam plant at nitrate plant No. 2 for $4,500,000 or to lease it at 4 per cent of this sum annually; to pay additional sums as units above eight are added to the hydro-electric plant; to build dam No. 3 themselves, paying two-thirds of the cost, the remainder to be paid by the government because of navigation improvement, or to have the government build this dam and lease it at 4 per cent; to furnish power at cost for fertilizer production, and to organize a fertilizer company.

Steubenville Bridge Stiffening Trusses Again Buckle

On April 20 the stiffening trusses in the Ohio side span of the suspension bridge across the Ohio River at Steubenville buckled while several cars of gravel were crossing the bridge. The top chords of both trusses buckled for the length of two panels, and the top laterals and several web members also were distorted. A similar accident occurred in the West Virginia side span a year ago (May 15, 1923, see *Engineering News-Record*, May 31, 1923, p. 976).

At the time of the present accident a train of two flat cars and a motor car carrying gravel was being moved across the bridge. At the time this train was traversing the Ohio side span it was passed by an interurban car on the other track. The failure was directly due to this overloading. The load on the bridge at the time was several times as great as the limit allowed after the accident of last year, when an investigation of the stresses in the structure and its load carrying capacity was made by Robinson & Steinman, consulting engineers, New York. In that investigation the stiffening trusses were found to be under heavy stress from camber, and the suspenders were subsequently readjusted to eliminate this camber stress. It was found further that extensive reinforcement of the structure was necessary to make it suitable for present-day traffic loads. Pending the carrying out of reinforcement in accordance with these recommendations, the chief engineer of the bridge, J. L. Fritsch, ordered that the loading be limited to one loaded car per track on the structure at any one time. Violation of this order was the direct cause of the present accident. The failure occurred in the portion of the structure known to be subject to the maximum stress intensity. It is estimated that at the time of the failure the stress in the truss chords was nearly three times the maximum limit permissible.

Estimated Total Hetch Hetchy Cost is $78,000,000

The total cost of the entire Hetch Hetchy project from the mountain reservoir to Crystal Springs reservoir on the San Francisco peninsula, according to a recent statement by M. M. O'Shaughnessy, city engineer of San Francisco, will be $78,000,000.

Up to Jan. 1, 1925, the total spent on the project will be $45,000,000 (including a bond discount of approximately $3,000,000) which covers the 18-mile tunnel, dams and other work in the mountain division, most of the work on Moccasin Creek hydro-electric plant and the construction of the 60-in. pipe line from Crystal Springs reservoir to Irvington.

The estimated cost for the section of the aqueduct yet to be built from Moccasin Creek to Irvington is $33,000,000. This portion of the project, known as the San Joaquin Valley division, includes 17 miles of tunnels on the easterly side of the San Joaquin Valley and 30 miles of tunnels to the west of that valley.

Los Angeles Sewage Screening Plant Capacity

The total normal capacity of the new sewage screening plant for the city of Los Angeles, recently completed at Hyperion, is 80 m.g.d. and the maximum capacity 120 m.g.d. The plant, which was mentioned in our issue of April 17, p. 709, consists of eight Dorrco screenig units, each with a normal capacity of 10 m.g.d.

Floods in the Potomac

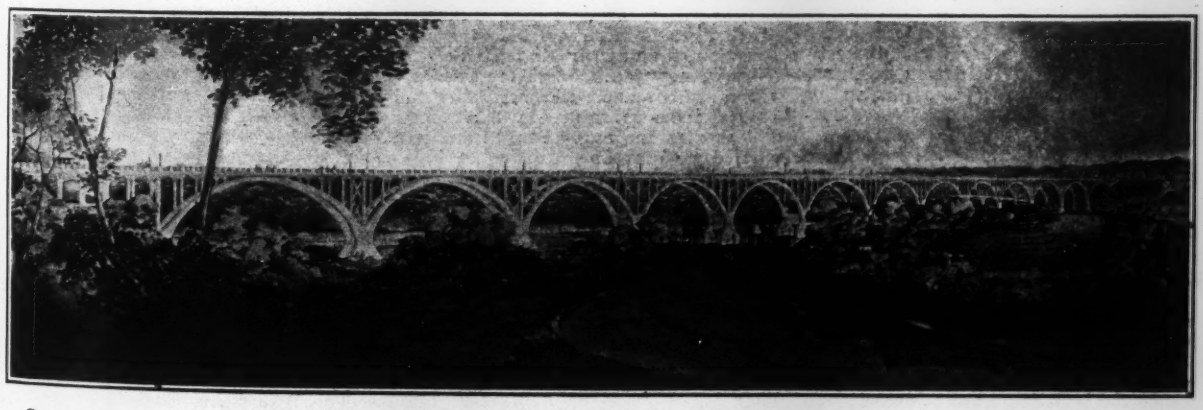
High water in the Potomac and its upper tributaries, especially the Shenandoah, caused considerable miner damage last week. The river was in flood for a comparatively short time and the damage was mostly to riverside houses and to a few highway bridges. At Washington there was some concern for a time but the peak of the flood passed without serious trouble.

Statements in the press that there was unprecedented high water at Washington and nearby points were unfounded. The stage of the Potomac at Key Bridge (Georgetown); Chain Bridge (between Washington and Great Falls), and at Great Falls has been exceeded on several occasions, while the great freshet of 1889 resulted in a stage at Key Bridge 5 ft. higher than the recent level.

Mean low water at Washington is zero, as the Potomac as far up as Chain Bridge, above Washington, is a tidal estuary. During the recent freshet, the gage at Key Bridge read 13.5 ft.; at Chain Bridge, 40 ft. and at Great Falls, 158 ft. The corresponding figures in 1889 were 18.5 at Key Bridge; 43.1 at Chain Bridge and 164 ft. at Great Falls.

In 1889 lower Pennsylvania Avenue was flooded. Prior to the installation of tide gates in the sewers of Washington, water on a number of occasions backed up into Pennsylvania Avenue. During the recent freshet there was no flooding in Washington except at the points where some development, mostly boat houses, had encroached on the banks of the river. Contributing factors which have increased the immunity of Washington from floods by accelerating run-off are the confining of tidal creeks, at the foot of Capitol Hill and James Creek, a mile further uptown, to the sewer system.

Perspective Drawing of the Fort Snelling-Mendota Bridge



Contract was recently let for the construction of the reinforced-concrete bridge which will span the Minnesota River connecting Fort Snelling with Mendota. The contract price is $1,870,000 and the Koss Construction Co. will do the work. The Walter H. Wheeler and C. A. P. Turner companies are the engineers.

The bridge is to be 4,119 ft. in length and will contain twelve 304-ft. spans. The roadway will be 45 ft. between curbs with a 6-ft. sidewalk on each side. Hand railing will be panel concrete 4 ft. 3 in. high with panel steel railing 3 ft. 6 in. high between posts.

The bridge design consists of cylindrical reinforced-concrete caissons sunk to firm bearings, four to each pier, the caissons being 14 ft. in diameter with cutting edges 22 ft. in diameter. It is probable that they will be sunk by the open-dredge method, concrete shells being built up as caissons are lowered. Superstructure is to be ribbed arch construction, two ribs to each span. The deck will be supported from ribs on columns and consists of flat slab design with depressions over the columns. The roadway is designed to carry double-track street car lines. The bridge will attain a maximum height of 120 ft. above the river.

Kentucky Road Contracts Declared Invalid

Court Rules That Highway Commission Cannot Pledge Funds Beyond Next Session of Legislature

Reversing a decision of the Circuit Court the Kentucky Court of Appeals has declared invalid state road contracts aggregating nearly $3,000,000 which were awarded Dec. 10, 1923. The decision was the outcome of friendly litigation brought, to determine the question of validity, by the Kentucky Association of Highway Contractors.

The contracts involved in the litigation were made Dec. 10, 1923, aggregating a total estimated cost of $2,994,618.35. At that time there were outstanding road warrants and unpaid accounts on estimates of $2,266,788.66; and uncompleted contracts in addition to an estimated total of $8,395,234.23. Of these sums a considerable portion will be ultimately paid from Federal aid and county gifts.

Giving the road fund credit for all of its estimated revenue for the fiscal year ending June 30, 1924, including the *ad valorem*, automobile license and gasoline sales taxes, the funds in sight according to the testimony of the state highway engineer were sufficient to pay the state's portion of all the road completions up to that time. This was based on the estimate that not exceeding 60 per cent of the work on unfinished contracts let prior to Dec. 10 would be completed, and not more than 30 per cent of the contracts involved in this litigation.

It was conceded by all that the total estimated cost of the contracts outstanding, including those let Dec. 10, was greater than the total estimated cash and revenue for the fiscal year ending June 30, 1924.

Main Question Involved

The main question therefore squarely presented was whether there was any legal limit upon the power of the state highway department to make road contracts, and if so, whether in computing the operations of a fiscal year the estimated total of the contracts outstanding was the basis of computation, or the estimated total of completions during that period.

The court held that each legislature has unlimited power to levy taxes, subject however to the right of the next legislature to change the system; and that if contracts should be made pledging road funds beyond the next biennial session of the legislature, this would limit the power of that legislature to exercise its own discretion in the levy of taxes and the appropriation of money. For that reason the court in effect takes two years as the unit, because the legislature meets once in two years and levies taxes and appropriates money for each of the two intervening years; therefore the court considers the status fixed for that period.

According to the court's decision, a road contract is a debt of the state for its full estimated amount, and the cash on hand, coupled with the estimated revenue for the two year period, must take care of the contracts outstanding during that period, and any valid deficit existing at the beginning of the time. The opinion is not explicit as to the division of contracts between the two years; but it seems reasonably clear that so long as the total contracts and valid claims outstanding are not greater than the estimated revenues for the two years period, the contracts are valid, and any warrants issued in anticipation of revenue will be valid.

Portland Bridge Scandal Causes Recall of County Commission

County Commissioners Charles Rudeen, Dow Walker and John Rankin were recalled by an overwhelming vote at a special election May 16 held in Portland, Ore., after they had been indicted on fraud charges growing out of the naming of Robert Kremers, also under indictment, as bridge engineer on the design and construction of three new bridges across the Willamette.

Amedee Smith, Grant Phegley and Erwin Taft, the new Multnomah County Commissioners, who will take office May 22, assert an effort will be made to set aside the present contracts on the bridges and secure other engineers to design and superintend their construction.

Propose Chicago Convention Hall

A $5,000,000 bond issue for converting the Fine Arts Building in Jackson Park into a great convention hall is to be submitted to the Chicago voters in June. This structure, which is considered a beautiful example of architectural design, was the only permanent exhibition building at the World's Fair of 1893 and recent steps for its improvement and reconditioning have led to the present proposal to utilize it for convention purposes. Plans prepared under the direction of E. J. Kelly, president of the South Park Commission, provide for a seating capacity of 20,000, or 30,000 with the addition of galleries.

Central of Georgia Ry. to Build 47 Miles of New Line

The Central of Georgia Railway Co. has been authorized by the Interstate Commerce Commission to revise the alignment and grades on its Columbus-Birmingham line between the stations of Opelika and Sterretts, Ala., a distance of 100 miles. The proposed revisions will make necessary a number of changes in location and the construction of an aggregate length of 47½ miles of new track. The proposed revision will reduce the rise and fall 1049 ft.; the curvature by 3,167 deg.; will shorten the line 4.1 miles and will eliminate 45 grade crossings of highways and two of railroads. The crossing elimination work will include a viaduct 430 ft. long across the town of Childersburg and the Southern Ry. Co.'s tracks.

The estimated cost of the work is $4,524,000 and the annual saving based on 1922 tonnage $555,490. The order of the Railway Commission requires the work to be commenced before July 1, 1924, and completed before Dec. 31, 1926.

WASHINGTON NOTES

The St. Lawrence Commission, of which Commerce Secretary Hoover, is head, and the Board of Engineers, of which Gen. Jadwin is chairman, expect to make a trip down the St. Lawrence as far as Montreal, with the idea of visualizing the situation which they have been called upon to consider. It is probable that the Canadian members of the Board of Engineers also will make the trip. The party will assemble at Niagara Falls, Ont., June 13, and will visit the Welland Canal and some of the operations of the Ontario Hydro Commission. The party then will proceed down the lake to Kingston and transfer to the St. Lawrence boat.

Further Testimony Is to Be Taken by the Senate Committee on Commerce in connection with legislation proposing the establishment of a national hydraulic laboratory. Commerce Secretary Hoover has been asked to testify as to the general achievements of research work. The thought of the committee, as a result of testimony previously taken, is that the problems of river training should be approached from a scientific angle as well as from the application of practical experience. Gen. Harry Taylor, the incoming Chief of Engineers; N. C. Grover, chief hydraulic engineer of the Geological Survey, and Elwood Mead, Commissioner of Reclamation, are among those who will testify.

Despite Pleas for Economy and charges that an excessive amount is being appropriated for the purchase of the Cape Cod Canal, the House of Representatives nevertheless has voted to take over the canal at a cost of $11,500,000. The arguments which influenced the vote doubtless were that the government during the war had assumed a moral, if not a legal obligation to take over the project.

The Fight of the Contractors on the day labor policy of the various government agencies was renewed during the consideration of the War Department appropriation bill in the Senate. An amendment which would have required the Mississippi River Commission to do half of its work by contract was disposed of with a point of order, but not until Senator King, of Utah, and Senator McKeller, of Tennessee, had made a very complete presentation of the contractors' side of the controversy. The contractors contend that the day-labor system under the direction of the Army engineers is more expensive and less efficient than the work let by contract.

The Rivers and Harbors Committee of the House of Representatives has agreed to eliminate from its bill the section which would have prohibited the issuance of a permit for the construction of power dams in navigable rivers or their tributaries until the Chief of Engineers has full information upon which to base a general plan for the most effective improvement of the river, or system of rivers, both for navigation and power development.

Track Elevation at Indianapolis to Cost $12,250,000

In continuation of the extensive program for eliminating grade crossings at Indianapolis, the beginning of work aggregating more than $12,000,000 is proposed for 1924. Plans are being prepared for the elevation of the Belt R.R. from Prospect St. to West 18th St., a project involving the elevation of approximately five miles of four-track and 2½ miles of double-track line. It necessitates the construction of about thirty subways with connecting retaining walls in addition to undergrade construction for seven separate intersecting railroad lines. About 55 industrial connections will be disturbed, requiring extensive remodeling to secure service from the elevated line. As a part of this work, the Belt R.R. plans the construction of a new reinforced-concrete arch bridge across White River to replace the present steel bridge. This entire work is estimated to cost $10,000,000.

Plans are also under way for track elevation on the parallel lines of the Pennsylvania R.R. and the Cincinnati, Indianapolis & Western R.R. from Davidson St. to State St. This will involve the elevation of approximately three-quarters of a mile of main-track facilities and the construction of five subways at an estimated cost of $1,500,000. The Cleveland, Cincinnati, Chicago & St. Louis R.R. and the New York, Chicago & St. Louis R.R. (L. E. & W. District) which are parallel lines within the downtown district, are also preparing plans for the elevation of their lines from East Market St. to Massachusetts Ave., about one-half mile of main track, together with the construction of four subways with connecting retaining walls. This work is estimated to cost $750,000.

California Builders Organize

At a convention of some fifty representatives from industrial centers throughout California, held in Oakland, May 2, the California State Builders' Association was organized. A set of resolutions was drawn up embodying at once (1) a statement of the fundamental principles of the organization and (2) the subjects for investigation and report by committees. Closer co-operation among the members of the building industry and with the general public, and the enactment of state and local laws in the interest of ethical and business-like procedure in connection with the business of construction are the principal purposes of the organization.

The officers elected are as follows: president, Horace D. Jones, general contractor and president of the Building Contractors' Association of Alameda County; first vice-president, Glen E. Arbogast, Los Angeles; second vice-president, John Biller, president of the General Contractors of San Francisco; third vice-president, O. H. Chain, general contractor, president Stockton Builders' Exchange; secretary-treasurer, W. F. Breuer, Oakland. An advisory board comprising representatives of the Builders' Exchanges of thirteen counties was also elected.

Spokane Building Collapse Under Investigation

Through causes which are being rigidly investigated the entire 320 tons of steelwork in the four-story Masonic Temple at Spokane, Wash., failed on May 10. Steel erection which was being done by the Maryland Casualty Co. as subcontractor under Fred Phair, general contractor, was immediately stopped pending the investigation. The Washington Department of Labor and Industry has appointed C. A. Burnette and B. J. Garnett an engineer board to investigate the cause of the failure, which resulted in the death of one workman and the serious injury of the second, and to report as to how best safety can be assured workmen in erecting such structures.

Engineer Heads Commission Ticket and Becomes Mayor

Henry A. Lardner, vice-president of the J. G. White Engineering Corporation of New York City, headed the five town commissioners elected by popular vote at Montclair, N. J., on May 13. At the organization of the commission on May 20 Mr. Lardner was chosen as mayor.

Of 7,660 votes counted Mr. Lardner had 4,085 on first choice and 4,342 against the requisite 3,831 for a majority of the valid votes cast. Only one other candidate was elected by first-choice votes while the two lowest got on the commission by pluralities only, even after adding second and other choices. There were 18 candidates to fill five commissionerships. About 78 per cent of those registered voted.

Mr. Lardner ran at the request of some fifty leading engineers of the town and had the endorsement of the Montclair Municipal League, a non-partisan voters' organization. The League gave wide publicity to a report on the local water situation, made by the public improvement committee of the League, composed of M. N. Baker, associate editor *Engineering News-Record*, Edward S. Cole, president the Pitometer Co., and Percy H. Thomas, an electrical engineer. This report reviewed adversely certain claims made by the three commissioners up for re-election, particularly by the mayor of the past four years, to the effect that they had "settled" the local water question. The mayor stood sixth on the list of candidates.

May License D. C. Architects

A bill providing for the examination and registration of architects in the District of Columbia has been passed by the Senate. Some objection was raised to the measure by Senator King, of Utah, who said that "too often in our municipalities there is a disposition on the part of a few of the elite in each profession to control the profession and to determine who shall enter it. They set up a machine by which they eliminate from active practice those who do not measure up to such standards as they set."

Random Lines

Inside Stuff

Sir—I've been considerably interested in reading the column in the *Engineering News-Record* that sets forth the diversified kinds of engineers (Exterminating, etc.).

Last evening I visited a teacher friend and heard the following true incident related:

> A man was filling out the application blank in one of the New York City public libraries. This requires a person to state his occupation. The man wrote "Irrigation of colons"; the young lady librarian said "Oh, yes, you're an engineer."

So I wondered if his card from then on would read

"Intestinal Engineer."

JANE DOE.

* * *

Going Back

The engineer as a romantic figure must be slipping. Last week's Satevepost has a story in which he plays a most ignominious part, being absolutely overshadowed by a horny-handed individual known as a "hard rock man." *Labor omnia vinoit*. The insult is made just a trifle worse by the fact that the author drags in, in disparagement of the engineer, that moth-eaten yarn of the foreman who when asked by the engineer where his plans were said "I don't know whar the pitcher is, but over yonduh's yer bridge I built." Only this time it's a soft-ground shaft.

* * *

"Coming Meetings"

Cincinnati Chapter, American Society of Mechanical Engineers, May 22, 1924. At the Literary Club Rooms. Subject: The Practical Application of the X-Ray to the Atomic Structure of Engineering Materials. Speaker: Walter Zoller, University of Cincinnati. Subject: Engineering Principles Involved in the Fabrication of Good Gravy. Speaker: Monsieur Le Bion Poissou, Ph.D., M.E.E. and Ph. Die, a noted Cuisine Engineer of Cincinnati.

* * *

In the Last Mail

Man Engineering — Sherman Service, Ltd., Production Engineers, Toronto, Ont.

Export Engineer — Gleaned from the society columns; a gentleman of that title is about to get married.

Organization Engineer—J. Paul Swain, of Louisville, Ky. His specialty is "organizing and conducting financial and publicity campaigns."

* * *

In giving some of the popular statistics concerning the recently completed Shandaken Tunnel, the Brooklyn Eagle says:

> The drill holes, if placed end to end, would total 3,000,000 ft.

Edward F. Terry

Edward F. Terry, whose associates termed him one of the most successful construction engineers in America, and whose death was noted in these columns last week, began life on a New England farm. He was born near Concord, New Hampshire, in 1857. Both of his parents died while he was very young, and he was sent to live with an uncle in Wisconsin. As a boy, the railroad and everything that pertained to its building and operation interested him and he spent most of his spare time with the workmen along the tracks.

Michael Riney, an old time bridge builder, took a liking to the young man and offered him a job as a riveter. That was before the days of electric tools and the job of riveting was arduous, but young Terry was a physical giant and thrived on hard work. Later Riney was badly hurt in Rochester, N. Y., while working on a viaduct for the Rochester Bridge Works. Terry was put in charge of the work in his place. He finished the job satisfactorily and his real career as a leader in steel construction then began.

Mr. Terry directed construction work shortly afterwards for the Youngstown Bridge Co., and built the steel arch bridge at St. Paul, Minnesota. Altogether he bridged the Mississippi River five times as well as erecting spans over the Missouri and other rivers in the middle west. Later he did much construction work on the Union Pacific R.R. in Idaho and Oregon under George H. Pegram.

Mr. Terry formed a partnership with Frederick Tench, under the firm name of Terry and Tench Construction Co., in 1895, their first contract being the erection of the New York Central four-track drawbridge over the Harlem river, the first of its kind. Since then they have built many bridges and elevated railroads. Mr. Terry had personal charge of the third tracking of the 2nd, 3rd, and 9th Avenue Elevated roads in New York. He also directed the erection of the Manhattan Bridge. The Boston Elevated R.R., Grand Central Terminal, Biltmore Hotel and other big steel construction contracts were handled by his firm. Three of the city of New York's piers at Stapleton, S. I., were built under his firm's direction.

During the war Mr. Terry formed the Terry Shipbuilding Corporation at Savannah, Ga.

Engineers Address New England Health Institute

A half dozen engineers and chemists were included on the "faculty" of more than eighty members that addressed the New England Health Institute at Boston during the week of May 5 to 10. The institute was held under the joint auspices of the U. S. Public Health Service, the various state health departments of New England, the Yale and Harvard schools of public health, the departments of biology and public health of the Massachusetts Institute of Technology and Simmons College, with Dr. Eugene R. Kelly, State Commissioner of Health of Massachusetts, as director. Thirteen "courses" were offered, including public health administration, sanitation and engineering, and industrial hygiene. The chairman of the section on sanitation and engineering was I. V. Hitchcock, assistant professor of public health at Yale University.

Papers on engineering and related subjects included: "Sanitation of Swimming Pools and Other Bathing Places," Stephen DeM. Gage, Providence; "Private Water Supplies and Their Dangers," C. P. Moat, Burlington, Vt.; "Sewage Disposal and Drainage," Prof. George C. Whipple of Harvard University; "Garbage Collection and Disposal," M. N. Baker, New York City; "Some Unsolved Problems of Public Health," Prof. C-E. A. Winslow, Yale University; "Stream Pollution by Industrial Waste and Its Control," J. Frederick Jackson, Hartford; "Water Supplies and Their Protection," X. H. Goodnough, Boston.

Engineering Societies

Calendar

Annual Meetings

AMERICAN WATER WORKS ASSOCIATION, New York City; Annual Convention, New York City, May 19-24, 1924.

AMERICAN ASSOCIATION OF ENGINEERS, Chicago, Ill.; Annual Meeting, San Francisco, Calif., June 11-13, 1924.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Annual Convention, June 18-20, Pasadena, Calif.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia, Pa.; Annual Meeting, Atlantic City, N. J., June 23-28, 1924.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION, University of Pittsburgh; Annual Meeting, Boulder, Colo., June 25-28.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Petersburg, Fla.; Annual Convention, Boston, Mass., Sept. 29-Oct. 3, 1924.

The New England Water-Works Association will hold its annual convention Sept. 23 to 26 inclusive at Rochester, N. Y. Headquarters will be at the Powers Hotel.

Personal Notes

MUSSON & GALE, engineers and accountants, Oklahoma City, Okla., announce that by reason of increase in their business they have separated their civil work into a department at the head of which is Colonel Frank B. King, consulting engineer, who has been president of the Oklahoma City chapter of the American Association of Engineers and of the Oklahoma Society of Engineers, who served as lieutenant-colonel and colonel of engineers in France, and who has practiced civil engineering in Oklahoma for twenty years.

RAY E. BEHRENS, formerly county engineer of Waukesha County, Wis., has been appointed assistant civil engineer in Milwaukee County, for service in the department of regional planning and zoning.

WALTER C. BENEDICT has resigned as district engineer of the Buffalo district of the Empire Engineering Co., Inc., to become president of the Twin City Construction Corp. of North Tonawanda, N. Y. Associated with Mr. Benedict in the company are Fred. W. Ives, former president of the New York State Builders Supply Association, and William E. O'Reilly, formerly of the firm of Bewley & O'Rielly, Inc., contractors of Lockport, N. Y.

GEORGE F. WIEGHARDT, formerly highway engineer for the city of Baltimore and for some time engaged in engineering work in Reading, Pa., has been appointed business manager for the Baltimore public schools. Before he was made highway engineer Mr. Wieghardt was assistant engineer in the water department of Baltimore.

WILLIAM C. RUDD has established an office as consulting engineer at 307 Hazen Bldg., Main and 9th Sts., Cincinnati, Ohio, for special practice in steam engineering and combustion for water-works, power plants, heating plants and for industries. Mr. Rudd has been in similar work for twelve years, for the past year associated with George W. Hubley, consulting engineer of Louisville, Ky., and for the six preceding years engineer of water service for the Louisville & Nashville Railroad Co.

THE DOCK & TERMINAL ENGINEERING CO. has acquired the engineering business formerly conducted by the Cleveland Dock Engineering Co. and will continue with Cleveland office at 4614 Prospect Ave. and New York City office at 15 Park Row, and with the following personnel: Gaylord W. Feaga, president; Joseph S. Ruble, vice-president; James D. Carey, secretary; Edgar B. Thomas, chief engineer; and Wilbur J. Watson, consulting engineer.

THOMAS W. SASSCER has been promoted to be assistant construction engineer in the highways department of the city of Baltimore, Md. Frank A. Lucas, Ferdinand S. Schmiedeke, Edward W. Boyce, Harry J. Lummis, Jr., and Rudolph F. Zerner have been appointed assistant topographical engineers in the city surveyor's department, and John B. McCrone, Jr., an engineering aid in the same department. Leon Small, for several years assistant engineer in the water department, has been appointed mechanical engineer in that department.

M. J. STINCHFIELD, JR., assistant state engineer for the Indiana Conservation Department for the past three years, has resigned to take charge of the engineering staff of the Walb Construction Co., LaGrange, Ind., and will

be succeeded by DENZIL DOGGETT, who has been working with him. Mr Stinchfield has in his three years' service built a number of roads in state parks, designed and constructed water and sewage systems in parks and been connected with major drainage projects.

F. L. C. BOND, chief engineer of the Central Region, Canadian National Rys., has been appointed general superintendent of the Central Region. T. T. IRVING, heretofore chief engineer of the Grand Trunk Western portion of the Canadian National Rys. at Detroit, succeeds Mr. Bond.

W. S. BURNETT, heretofore district engineer maintenance-of-way, Cleveland, Cincinnati, Chicago & St. Louis Ry., has been appointed engineer of construction with headquarters at Indianapolis. A. M. TURNER, district engineer of the same system at Indianapolis, has resigned.

WILLIAM J. STEWART, assistant city engineer of Rochester, N. Y., recently resigned after having been in the service of that city over fifty years.

JOSEPH H. BENTLEY, member of the engineering firm of Bentley and Holmgren, Bridgeport, Conn., was elected president of the Engineers' Club, his city, at the recent annual meeting.

GANNETT, SEELYE & FLEMING, ENGINEERS, INC., of Harrisburg, Pa., and Memphis, Tenn., has been organized and takes over the engineering and construction work of Gannett, Seelye & Fleming, Inc., while the latter will continue in the financing, management and development of public utilities and industrial properties. In the new corporation in addition to Farley Gannett, Theodore E. Seelye and Samuel W. Fleming, Jr., are Frank H. Eastman, Dartmouth College, construction manager; W. H. Corddry, Lehigh University, second vice-president and manager of the Memphis office; and J. D. Carpenter, Pennsylvania State College.

NICHOLAS S. HILL, JR., consulting engineer, New York City, announces that Mayo Tolman has become associated with him as sanitary engineer in his chemical and bacteriological laboratory and in sanitary and epidemiological work. Mr. Mayo was chief engineer of the West Virginia State Department of Health several years ago, and since then has served as director of health and on research work for the Community Councils of National Defense, Metropolitan Survey of the Interchurch World Movement, American Public Health Association, and American Institute of Medicine, and also carried on a private practice in water supply and sewer design and construction.

EDWARD FLAD of St. Louis has been selected by Secretary of War Weeks to be the civilian engineer member of the Mississippi River Commission. His nomination will be sent to the Senate by President Coolidge at an early date. Mr. Flad was water commissioner for St. Louis from 1899 to 1903. In 1917 he was appointed a member of the Missouri Public Service Commission by Governor Gardner. He resigned from that commission in October, 1921, to resume private practice.

S. V. CORTELYOU has been appointed division engineer for the California Highway Commission in charge of Division 7, consisting of the counties of Ventura, Los Angeles, Orange, San Diego and southeastern Kern, with headquarters in Los Angeles. Mr. Cortelyou has been in the service of the California Highway Commission since 1912, most recently as acting chief of the Los Angeles highway district. He had prior to that time done government engineering work in the Philippines.

CHARLES M. ENNIS, for three years assistant city engineer at Sacramento, Calif., has been appointed city engineer of Chico, Calif., succeeding F. A. Lammiman, resigned.

M. S. NUDGIUS has left the service of the Virginia State Highway Commission, after six years' connection as locating project and resident engineer, to engage in the contracting business at South Roanoke, Va.

THE AUSTIN CO., engineers and builders, announce the removal of their Chicago offices to 160 N. LaSalle St., with increased facilities for service in industrial building work.

A. T. HOUSE has been appointed city engineer at Shelbyville, Ind., to serve for one year. Mr. House is city engineer also of Franklin, Greenwood, and Edinburg, Ind.

CAUSBEY ENGINEERING CO., INC., Philadelphia, Pa., announces its removal from 1011 Chestnut St. to the Bankers Trust Bldg. The organization was created in 1921 but has recently been incorporated, and to its service in the design of electrical and mechanical layouts has added departments in hydro-electric power and steam power, design and construction of industrial plants, foundations, bridges, sanitation and reports and valuations.

THE UNITED ENGINEERS, INC., consulting engineers, Pittsburgh, Pa., recently removed from 303 Wood St. to 550 Century Bldg., where they will continue their business of design of structural steel and preparation of shop details.

R. D. VAN ALSTINE, city engineer of Long Beach, Calif., announces the organization of a division of sewers in the public service department of that city with Clyde F. Smith as engineer in charge. Mr. Smith is a graduate of Massachusetts Institute of Technology, was for two years sanitary engineer for the California Board of Health and for the last three years has practiced as consulting engineer at Berkeley, Calif.

WILLIAM H. SMITH, St. Louis, Mo., president of the McKelvey Construction Co., has, because of ill health, resigned both as president and as director of the company and has also disposed of his interests in the firm. James G. McKelvey succeeds Mr. Smith as president of the firm.

GEORGE L. HENDERSON, for the past two years drainage engineer for the Merced Irrigation District in California, has resigned to accept a position as assistant engineer on the Kern River Water Storage District with headquarters at Bakersfield, Calif. The Kern River project contemplates placing 250,000 acres under irrigation.

BASIL H. FRASER, for four years chief engineer of the Department of Marine and Fisheries, Ottawa, Canada, has been retired owing to ill health and will reside in Los Angeles, Calif. LOUIS E. COTE, who has been assistant chief engineer of the department, is serving as acting chief engineer.

LYNN S. ATKINSON, JR. and C. A. SPICER, general engineering contractors of Los Angeles, announce the organization of a new firm to be known as the Atkinson-Spicer Co. Pending incorporation the new company will be operated as a co-partnership with offices at 921 Chapman Building, Los Angeles. The Atkinson-Spicer Co. will complete the contract previously awarded to Lynn S. Atkinson, Jr., covering the construction of Section 8 of the Los Angeles city outfall sewer.

Obituary

JOHN E. CAMARDY, assistant city engineer at Lafayette, Ind., died recently at his home after a short illness. He was 59 years old and had been a resident of Lafayette all his life; at one time he was superintendent of the municipal water-works there.

GAYLORD D. WEEKS, vice-president of the Hedges-Weeks Construction Co., railroad masonry contractors, Springfield, Mo., died suddenly May 6 in a hospital in Kansas City, in his 45th year. Mr. Weeks was a graduate of the engineering department of the University of Iowa.

WILLIAM R. MCCRORY, district engineer on the city engineering staff of Seattle, Wash., died suddenly May 6, aged 43 years. Mr. McCrory, an engineering graduate of the University of Washington, had been in the city engineering office since 1906, as a computor, assistant district engineer and district engineer.

JAMES SWISHER, of Urbana, Ohio, who served twenty-five years (1889-1914) as county engineer of Champaign County, Ohio, and eight years as city engineer of Urbana, died in that city May 7, aged 75 years.

WARREN Y. SOPER, of Ottawa, Can., president of Ahearn & Soper, Ltd., electrical engineers, died May 13, aged 68 years. As member of several Canadian corporations Mr. Soper took an active part in introducing the electric railway system into Canada.

CLEMENT C. SMITH, civil engineer and surveyor, Wheeling, W. Va., head of the engineering firm of C. C. Smith & Sons, died in Wheeling May 11 after a week's illness. Mr. Smith had supervised the construction of some of the large bridges, tunnels and buildings in the Wheeling district.

From the Manufacturer's Point of View

A Point of Contact
Between Maker and User of
Construction Equipment and Materials

Construction Equipment—Past and Present

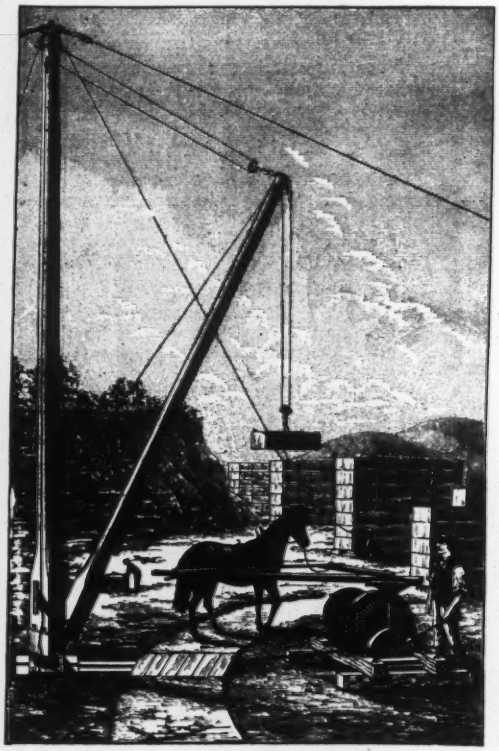
A Series of Historical Sketches of the Origin and Development of Machines for Contractors and Engineers

IV—Hoisting Engine

FROM the very earliest days the work of the engineer and the contractor has required the lifting and lowering of masses. While the hoist, in its hand-operated form, dates back many centuries, the mechanically operated machine made comparatively little headway toward its present state of perfection until about 1875. Prior to that time the operation of hoisting engines had been by means of a jawed clutch on a rapidly moving crankshaft, a faulty construction resulting in sudden shocks and jars, excessive wear and tear on the parts, and frequent breakages. A decided improvement was scored during the sixties with the advent of the loose drum with a clutch on the drum shaft running at a low rate of speed. The positive connection thus made when the gears were thrown into mesh, however, required great caution in operation and caused breakage of clutches, gear teeth and hoisting rope when the load met with a sudden check, such as catching on the side of a hatch of a vessel. These objections were recognized and many attempts were made to introduce a friction clutch connection between the drum shaft and the loose drum. These improvements took the form of grooved frictional gearing, toggle joint friction clutches, hub friction, and other devices, but none of them was fully satisfactory.

The Friction Drum—Joseph S. Mundy, of Newark, N. J., ushered in a new era in hoisting-engine design when he secured a patent, on Jan. 19, 1875, for a friction drum device described as consisting of "a male cone of hardwood, accurately fitting into a female cone of polished iron and pressed into contact by a screw operated by a hand lever and separated by a recoil or disengaging spring between the two surfaces." The friction drum was mounted loose on the shaft; the pressing together of the two surfaces of the friction and the hoisting drums caused the male cone to act as a wedge, binding the two surfaces together and causing the drum to rotate. By means of an operating lever the friction could be thrown in or, with the aid of the recoil spring, withdrawn, greatly improving the ease and sensitiveness of hoist operation. In some cases where no recoil spring was used it was found necessary to use a small pinch bar to separate the friction surfaces after hoisting a heavy load.

This friction drum feature was the first big step in the improvement of the hoisting engine and has been retained in principle in all of the modern machines now on the market. The validity of the friction drum patent was contested and upheld by the U. S. Circuit Court of the Southern District of New York in a decision rendered May 5, 1884. The patent in question was re-issued July 13, 1880, and numbered 9289. In one of his old catalogs dealing with the use of his hoisting engines in pile-driving work Mundy said: "I guarantee to strike with a 6½ x 12-in. cylinder engine and a 2,500-lb. hammer from 15 to 25 blows per minute, running the hammer from 12 to 25 ft. high every blow."



Early Form of Power Hoist Used on Railroad Bridge Pier Construction

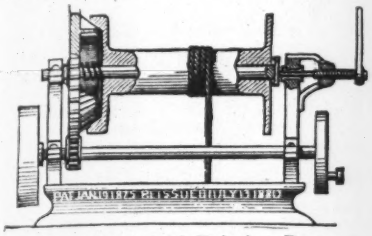
Mundy had started in business in 1869. In 1873 there was established another organization destined to play a leading role in the hoisting engine business—the Lidgerwood Manufacturing Co., headed by two brothers of that name, William Van Vleck, president, and John H., vice-president. In the early days the hoist was generally operated by a single-cylinder steam engine, often of 25 to 30 hp., which sufficed during the period when buildings were of comparatively low height. As structures increased in size, however, the demands upon the hoisting engine increased and a change was made from one to two cylinders to develop greater power and speed.

For bridge construction Mundy developed a multiple-drum special engine, illustrated herewith, which was first used by Baird Bros., bridge construction engineers of Pittsburgh. Three of these machines were used in erecting the Poughkeepsie bridge across the Hudson River, New York, and two in building the bridge across the Missouri River between Omaha, Neb., and Council Bluffs, Iowa. This equipment also served to raise and place the 522-ft. channel span of the Union Railroad bridge over the Ohio River at Hendersonville, Ky. The bridge construction engine, shown in the cut, is a 20-hp. machine with double 7 x 12-in. cylinders.

Cork Inserts—The first frictions were of wood segments. The Lidgerwood organization has since introduced cork inserts into these blocks and utilized the principle of a double instead of a single cone, the advantages claimed for these features being greatly increased holding power and absorption of such oil as may accidentally reach the friction surfaces, thereby destroying their adhesion. The cork projects 3/32 in. above the wood. To the Lidgerwood organization also is credited another important improvement, the patent friction pin oil box which provides constant and certain lubrication between the friction screw point, which is stationary when the drum is in operation, and the friction pin which revolves with the drum. This feature added greatly to the ease and economy of hoist operation.

Double Cones—Another of the veterans in the hoisting engine field is the Mead-Morrison Co. of Boston, established between 1876 and 1880 under the name of Rawson & Hittinger, subsequently changed to the Rawson & Morrison Manufacturing Co., and in 1904 to the present name. This company's first hoisting engine bearing a serial number was made in 1884. On this machine the drum consisted of two cast end flanges with plate steel barrel; the plate steel barrel, however, did not stand up under hard service and

soon crushed. For the drum construction cast iron, accurately machined all over, was later substituted. The friction in the early Mead-Morrison machines consisted of three shoes which expanded radially against an inner surface of one drum flange. These shoes were wood-lined and because of their small effective friction area the capacity of the early hoist was extremely low. The new models have double-cone asbestos friction lining fastened to cast-iron blocks which can move radially as the drum heats up due to slipping of frictions or brakes. Without this radial movement it is held to be imperative that the brake surface be on the opposite end of the drum to prevent drum expansion.

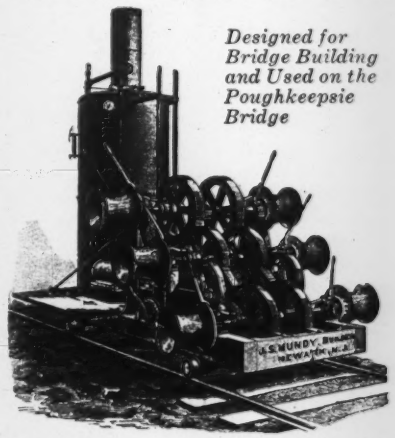


Mundy's Original Friction Drum

The early hoisting engine cylinders were made of small bore and long stroke; the opposite is true today. Instead of cylinder dimensions of 6¼ x 12 in., modern engines have 9 x 10-in. cylinders. The early drum springs could not be adjusted and, therefore, there was constant end pressure on the drum shaft, causing excessive wear of the side stand and babbitt bearings. Present-day machines, on the contrary, have a spring check held by two bolts passing through the gear so that there is no pressure against the drums when the friction lever is in the "off" position.

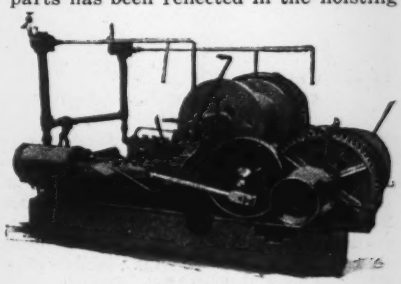
In the old days swinging was accomplished by prying the bull-wheel around with a crowbar. The beginning of the twentieth century, however, saw the introduction of swinging gear on the hoisting engine and the development of high speeds to deliver materials to the tall buildings then being constructed. The expanding use of the grab bucket and the dragline also had its influence on hoist design, being responsible, in part, for improvements in the three-drum hoist. For dragline and scraper operations the S. Flory Manufacturing Co., Bangor, Pa., developed what is claimed to be the first two-speed hoist.

Later Improvements — As years passed many mechanical details of the hoist were bettered. Solid side frames and webs were substituted for the old style of skeleton side frames, adding rigidity and insuring proper alignment of the drum and shaft bearings; drums were bronze-bushed instead of being mounted directly on the shaft. Open teeth ratchets were shrouded and removable bolted teeth introduced; other materials than wood were substituted for the friction blocks, including compositions containing asbestos. Forced feed lubrication replaced grease cups.

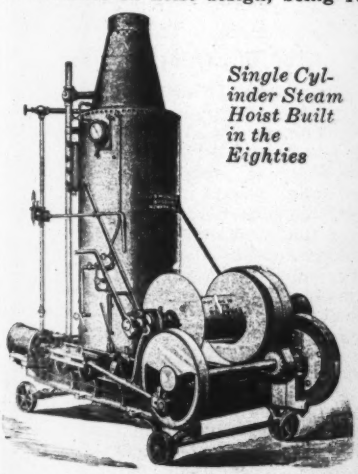


Designed for Bridge Building and Used on the Poughkeepsie Bridge

In later years the standardization of parts has been reflected in the hoisting engine business. Today hoists are made in two-drum units, the third drum being bolted on. In hoists driven by power other than steam standardization has gone one step further in that the double-drum unit can be sold as a belt hoist or a supplementary base can be attached at the rear to accommodate either an electric motor or a gasoline engine, thus giving on such a hoist the same drum, gears, brakes, friction parts and shafts as are found on a steam hoist of the same size.



An Old Mundy Model



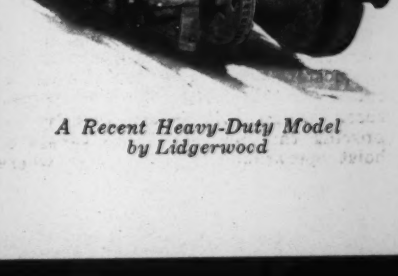
Single Cylinder Steam Hoist Built in the Eighties

The Electric Hoist—As in the case of the power shovel, dealt with in an article published in this journal May 1, p. 785, the power equipment of the hoisting engine underwent a change, one of the most important steps being the introduction of the hoist operated by electric motor. The Lidgerwood Co. shipped its first electric hoist in 1890. It quickly gained popularity in the building field, especially in cities where electric power could readily be delivered to the job. On city building work it removed the objection of steam and soot in addition to the added advantage of consuming power only while the actual hoisting operations were in progress. The electric hoist ushered in a number of improvements, among them automatic control to prevent overwinding, to hold the load in case of failure of the power supply and to stop automatically at predetermined floor levels.

Modern Three-Drum Hoisting Engine (Mead-Morrison)

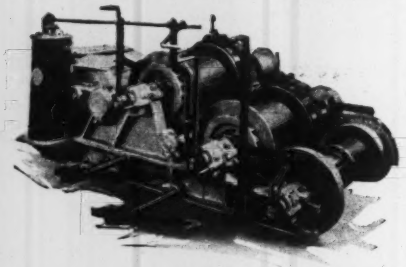
When the electric hoist was introduced, the 25-hp. motor was regarded as a large unit. But today hoists equipped with 100 and 150-hp. motors are not uncommon. Incidental to the use of large motors has come the necessity for friction clutches which would stand the higher speeds and heavier loads, and it was with this idea in mind that the Thomas Elevator Co., Chicago, patented in 1913 its band friction, which operates without a thrust bearing of any kind. This feature, together with the company's automatic motor brake, is pointed to as an important development in the art. In the development of its hoist the Thomas company, which was established in 1873, devoted particular attention to skyscraper construction, and in addition to producing a practical electric hoist for large building construction, introduced a two-speed band friction electric slack-line cableway hoist.

Following the electric hoist came the gasoline hoist in 1905 or thereabouts. This machine owes its development to construction conditions under which it was impossible to secure good boiler feed water, electric current, or solid fuel. One of the first gasoline hoists was used in connection with dredging work for the Florida East Coast Ry. extension through the Everglades; this was a Lidgerwood machine. The gaso-



A Recent Heavy-Duty Model by Lidgerwood

line hoist is now popular on general construction work. Fifteen-horsepower engines are common equipment for such hoists, although gasoline power plants up to 60 or 70 hp. are built. One of the latest developments is the incorporation



Latest Mundy Hoist Operated by Electric Power

of the light gasoline hoist with a tractor to form a mobile unit.

To the engineering contractor the hoisting engine has rendered service in a variety of operations, including derricks and cranes for building construction, draglines and grab buckets for excavation, dredging, mine and tunnel shafts, and as a special operation in railroad work, and in particular during the construction of the Panama Canal, for operating rapid unloaders in removing earth from flat cars.

Summing up progress during the past half century, the major improvements have related to the friction drum, swinging gear, automatic brakes, the introduction of electric and gasoline power, added rigidity of the frame, better alignment of working parts, improved bearings and lubrication, and grouped levers to secure maximum ease of control.

(The next article in the series on "Construction Equipment — Past and Present" will appear in an early issue.)

Business Notes

JOHN J. MOORE, for a long time connected with the Thomas Elevator Co., Chicago, has resigned to accept a position with the Day & Maddock Co., Cleveland agents for the Thomas Elevator Co.

BARBER-GREENE Co., Aurora, Ill., has just received from the State Highway Department of Pennsylvania an order for 34 gasoline-driven portable belt conveyors, which are scheduled for shipment this month in a train of twenty-nine cars.

BROWNING Co., Cleveland, manufacturer of locomotive cranes, announces that J. L. Levay has joined its sales force and will be attached to the Chicago office. H. K. Robinson has joined the Browning organization and will represent the company in the St. Louis territory.

GOOD ROADS MACHINERY Co., INC., Kennett Square, Pa., has discontinued its Boston office and established a branch in the city of Watertown, Mass., where both offices and warehouse have been established to serve the New England territory.

Wanted: Historical Notes on Construction Equipment

Makers and users of Construction Equipment are urged to cooperate with "Engineering News-Record" in supplying information which will add to the interest, accuracy and completeness of the series of articles now appearing under the head, "Construction Equipment—Past and Present."

The articles thus far published cover the rock drill, the power shovel, the concrete mixer, and the hoisting engine.

Others are planned on the road grader, the belt conveyor, the portable loader, the digging bucket, the trenching machine, the contractor's portable pump, and other standard types of plant.

Notes, photos or sketches, particularly relating to the old-time machines, will be welcome. They should be addressed to R. K. Tomlin, Jr., Associate Editor, Engineering News-Record, 10th Ave. at 36th St., New York, N. Y.

Concrete Mixer Makers Ratify Standards

Meeting with A.G.C. 15 Manufacturers Form First Affiliated Bureau of Contractors Organization

Washington Correspondence

Meeting in Chicago May 1 with Gen. R. C. Marshall, Jr., general manager of the Associated General Contractors, and other representatives of that organization, 15 manufacturers of concrete mixers, whose products constitute a high percentage of the country's yearly output, agreed upon a program of standardization which was ratified by the Executive Board of the A.G.C. at Cleveland, May 3.

The concrete mixer manufacturers, who recently disbanded their association, voted unanimously to form themselves into an affiliated bureau of the Associated General Contractors, thus becoming the first group to enter this new division of the contractors' association which, it is hoped, ultimately will include group bureaus representing all the major lines of producers of construction equipment.

The standards adopted by the manufacturers of concrete mixers provide for a rating to indicate the guaranteed working capacity in cubic feet of mixed concrete per batch; rating of boilers according to the A.S.M.E. horsepower rating; three standard sizes of paving mixers and six standard sizes of building mixers; and standards for other factors and parts.

It is provided that no non-standard mixers shall be manufactured after Oct. 1, next.

The standard sizes are as follows:

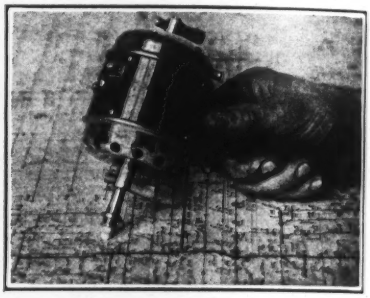
Paving Mixers—7-E; 13-E; 21-E.

Building Mixers — 3½-S; 5-S; 7-S; 14-S; 21-S; 28-S. Sizes below 3½-S and above 28-S are to be omitted from the standardization program for the present. Unless prior to Sept. 1, 1925, the 10-S is adopted as standard its manufacture shall cease.

Equipment and Materials

A Mechanical Ink Eraser

A motor-driven ink eraser is one of the latest additions to drafting-room equipment. The device illustrated herewith is manufactured by Charles F. Seymour, 22 Myrtle Ave., Swarthmore, Pa. Unlike the previous types of machines, in which the eraser was attached to a length of flexible shafting driven by a fixed motor, the present device combines the erasing and power elements in a single unit weighing 2 lb. which is not too heavy, it is claimed, for easy hand manipulation. The revolving motor produces a gyroscopic action which tends to hold the device at a uniform angle while the weight of the motor, it is claimed, is just sufficient to give the proper pressure on the drawing surface to eliminate a glazing of the eraser by the ink.



An important feature of the equipment is the form and composition of the abrasive material used for the rubber. Mechanically operated disk erasers, past experience has proved, often cut through or burn the drawing surface. In the Seymour machine the eraser is in the form of a cylinder of special composition which is designed not to injure the drawing surface provided the machine is kept moving slightly so as not to generate heat. The motor is started and stopped with the thumb of the hand holding the instrument and variable speeds of rotation may also be produced.

Allis-Chalmers Takes Over Part of Worthington Line

The Power & Mining Works of the Worthington Pump & Machinery Corporation at Cudahy, Wis., have been closed down following a decision by the company to discontinue its line of crushing, cement, mining and creosoting machinery. Arrangements have been made whereby the Allis-Chalmers Manufacturing Co., Milwaukee, takes over the Worthington records, patents, drawings and patterns for the equipment above noted and will continue its manufacture.

FRED J. MERSHON, for many years export sales manager of the Industrial Works, Bay City, Mich., has assumed charge of the company's branch office in Detroit.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Price Declines Exceed Advances—Most Materials Show No Change

Many buyers believe that prices will go lower during the present building season. That this is little more than an opinion is shown by a comparison of present price quotations with those of a month ago, four months ago and a year ago.

Despite slowness of demand and frequent price shading it will be seen from the accompanying tables that prices of very few basic materials are actually declining.

Mill shipments are so prompt at present that warehouses are not maintaining large stocks, which means lighter orders. Eventually, when stocks are depleted, there will be a resumption of demand and possibly higher prices.

Of twenty-four basic materials (f.o.b. New York unless otherwise specified) on which prices are quoted regularly in *Engineering News-Record*, first issue of each month, only eight have declined since Jan. 1, while three advanced, as shown in Table I.

Thirteen of the twenty-four have shown no change in price since Jan. 1, 1924. They are: Cast-iron pipe, sewer pipe, sand, common lump lime, cement, structural rivets, dynamite, wrought-steel pipe, granite paving blocks, steel rails, clay drain tile, metal lath and wire nails.

Compared with a year ago, eight materials show declines and seven advanced in price, see Table II.

Finally, it is found that nine of the twenty-four materials are quoted at the same price today as a year ago, as shown by Table III.

Although lumber is about 120 per cent and steel 60 per cent above their respective 1913 levels, the trend in both is downward.

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for in Construction News, pp. 295 to 309, are the following:

Municipal building, Brooklyn, N. Y. by boro. pres., $6,000,000; paving, Chicago, Ill., by bd. of local impvts., $1,522,500; Exchequer dam, Merced, Calif., over $1,000,000; High School, Asbury Park, N. J., $1,000,000.

Large Contracts Let During Week

Among the week's announcements of contracts awarded in Construction News, pp. 295 to 309, are the following:

Asylum, Secaucus, N. J., Hudson Co. to W. H. and F. W. Cane Co., Jersey City, $3,367,111.

Gas Station, Syracuse, N. Y., Syracuse Lighting Co. to United Gas Impvt. Contg. Co., $3,000,000.

Home, Cartierville, Que., to A. Boileau, Montreal, $2,500,000.

Hospital Buildings, Philadelphia, Pa.,

(*Continued on p. 920*)

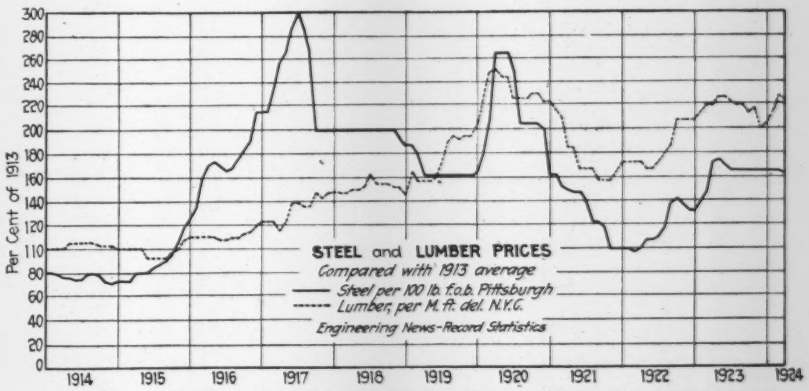


TABLE III—MATERIALS QUOTED AT SAME PRICE TODAY AS YEAR AGO

	May, 1924	May, 1923
Sewer pipe, 6-in., per ft.	$0.24	$0.24
Sand, per cu.yd.	1.25	1.25
Common lump lime, per 280-lb. bbl., net	3.00@3.25	3.00@3.25
Wrought steel pipe, black, 1 to 3-in., discount, Pittsburgh basing card	62%	62%
Steel rails, standard, f.o.b. Pittsburgh, per ton	$43.00	$43.00
Clay drain-tile, 3-in., per 1000 lin.ft.	45.00	45.00
Expanded metal lath, 2.2 lb., per 100 yd.	22.00	22.00
Wire nails, per keg., f.o.b. Pittsburgh	3.00	2.90@3.10
Common brick, wholesale, per M.	20.00	20.00

TABLE I—PRICE CHANGES SINCE JAN. 1, 1924

	1924				
	Jan.	Feb.	Mar.	Apr.	May
Steel shapes, per 100 lb.	$3.64	$3.64	$3.64	$3.64	—$3.59
Steel bars, ½-in., per 100 lb.	3.54	3.54	3.54	3.54	—3.49
Linseed oil, per gal.	.95	.95	+.97	—.95	+.98
Pine timbers, 3x12, 20 ft., per M. ft. b.m.	53.00	+56.00	+60.00	—59.00	—58.00
Gravel, ¾-in., per cu.yd.	2.00	2.00	2.00	2.00	—1.75
Common brick, per M. (wholesale)	20.00	+20@22	20@22	—20.00	20.00
Hollow tile, 4x12x12, each	.1179	.1179	.1179	.1179	—.1162
Crushed stone, ¾-in., per cu.yd.	1.75	+1.85	1.85	1.85	1.85
White and red lead, dry, per lb.	.14	+.14½	+.15	.15	.15
Wood blocks, 3-in., per sq.yd.	2.58	—2.29	2.29	2.29	2.29
Pig iron, No. 2 fdry., Birmingham, per ton	22.00	+23.00	+23@24	—22.50@23	—22@23

Note: (—) = decline; (+) = advance.

TABLE II—CURRENT PRICES COMPARED WITH YEAR AGO

	May, 1924	May, 1923
ADVANCED		
Cast-iron pipe, 6-in., per ton	$61.60@63.60	$58.50
Granite paving blocks, 5-in., per M.	140.00	134.50
Crushed stone, ¾-in., per cu.yd.	1.85	1.75
Steel bars, ½-in. per 100 lb.	3.49	3.34
Steel shapes, per 100 lb.	3.59	3.44
Red and white lead, dry, per lb.	.15	.14½
Structural rivets, ¾-in., per 100 lb.	4.40	4.00
DECLINED		
Wood blocks, 3-in., 16 treat., per sq.yd.	$2.29	$2.63
Cement, per bbl., without bags, del.	2.50@2.60	2.70@2.80
Hollow tile, 4-x12-x12-in., each	.1162	.1573
Linseed oil, raw, 5 bbl., per gal.	.98	1.16
Pine timbers, 3-x12-in., 20 ft., per M. ft., b. m.	58.00	60.00
Dynamite, 40% gelatin, per lb.	.27	.27½
Gravel, ¾-in., per cu.yd.	1.75	2.25
Pig iron, No. 2 fdry., Birmingham, per ton	22@23	27.00

How Labor and Materials Costs Influence Highway Building

The volume of highway construction is considerably influenced by changes in materials and labor prices, according to the U. S. Bureau of Public Roads. These vary not only in the United States as a whole but between sections of the country. To show the variations between sections it may be noted that in the East South Central States in 1915 labor was 12 cents per hour, while in New England it was 20 cents and in the Pacific and Mountain States it was 26 cents. In all of these States the price rose until in 1920 it was 32 cents in the East South Central States, 49 cents in New England, and from 55 to 60 cents in the Pacific and Mountain States. It dropped again in 1922 in the East South Central States to 20 cents, in New England to 39 cents and 48 cents in the Pacific States, rising again slightly in 1923 to 22 cents in the East South Central, 51 cents in the New England States and 54 cents in the Pacific States.

There was a similar range for prices of road-building materials which gradually rose until in 1920 they were about 150 per cent above the 1915 figures for lumber, a little over 100 per cent for steel, and about 100 per cent for cement. From this high point all materials dropped until 1922.

The results in road construction were that the price of common excavation rose steadily to 1920, fell back again until 1922, and then began to rise again. Similar movements took place in structural concrete and in the pavements. These fluctuations taken together produce variations in the total cost per mile from year to year. For example, if we assume a road with 8,000 cubic yards of excavation, 10,560 square yards of pavement and 75 cubic yards of structural concrete, and use the prevailing labor and material prices for an expenditure of $100,000, the mileages we would have been able to build are:

Year	United States Miles	East South Central Miles	New England Miles
1919	2.9	3.1	2.8
1920	2.4	2.5	1.9
1921	2.6	2.7	2.1
1922	3.3	3.3	2.3
1923	3.0	2.9	2.2

Large Contracts Let During Week

(*Continued from p. 919*)

to several contractors, total $2,307,734.

Power development, Watertown, N. Y., to U. G. I. Contg. Co., $2,000,000.

Hotel, Detroit, Mich., to O. Misch Co., $1,150,000.

High School, Roxbury, Mass. to T. O'Connor & Co., Cambridge, $1,437,130.

Hospital, Asyla, N. J., to several contractors, total $1,215,935.

Office and store, Boston, Mass., to W. A. and H. A. Root, $1,000,000.

Steel watermains, Cleveland, O., to D. Lowensohn, $294,115.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of May 1, the next, on June 5.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	$3.59	$3.80	$4.40	$3.30	$3.55	$4.20	$3.60	$3.60	$4.20
Structural rivets, 100 lb.	4.00	4.35	4.90	3.75	4.00	5.15	5.00	4.25	5.00
Reinforcing bars, ¾ in. up, 100 lb.	3.49	3.30	3.38	3.20	3.45	3.85	3.65	3.50	3.90
Steel pipe, black, 2½ to 6 in. lap, discount	44%	54.2%	43%	47%	55.05%	36%	36.80@49.10%	45%	47.43
Cast-iron pipe, 6 in. and over, ton	61.60@63.60	55.00	61.00	57.20@60.20	60.50	—68.00	59.00	65.00	60.00
Concreting Material:									
Cement without bags, bbl.	2.50@2.60	2.35	2.05	2.20	2.42	2.84	2.61	2.90	2.25
Gravel, ¾ in., cu.yd.	1.75	2.00	2.38	2.00	1.85	1.90	2.15	1.50	1.50
Sand, cu.yd.	1.25	1.40	2.00	2.00	—1.25	1.00	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd.	1.85	2.00	2.83	2.00	2.00	3.50	2.15	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	—60.00	40.00	60.22	53.50	—40.75	49@53	36.00	—25.00	65.00
Lime, finishing, hydrated, ton	18.20	22.50	20.00	20.00	25.50	24.00	22.60	24.00	21.00
Lime common, lump, per bbl.	3.00@3.25	1.65	1.85	1.50	1.40	2.70	2.10	2.80	10.50
Common brick, delivered, 1,000	23.65	12.00	14.10	11.00	15.00	12.00	15.50	15.00	17.50
Hollow building tile, 4x12x12, per block	Not used	.091	.11	.064	.075	.075	.....	.11	.12
Hollow partition tile 4x12x12, per block	.1162	.091	.11	.....	.....	.075	.108	.11	.....
Linseed oil, raw, 5 bbl. lots, gal.	.98	1.00	+1.14	.94	+1.08	+1.16	1.05	1.13	+1.23
Common Labor:									
Common labor, union, hour	.75	.30	.....	.....	.....	.50@.55	.55	.62½	.....
Common labor, non-union, hour	....	.25	.30@.50	.82½	.50@.55	.35@.50	.50	.62½	.25

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given; 45-5% means a discount of 45 and 5 per cent.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b.

Labor—Concrete laborers' rate, 93½c.; building laborers (pick and shovel men) 75c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.80 for Kelly Island and $1.70 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in iron bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on Douglas fir instead of pine. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 98.28). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 3-in., $47.43; 6-in. $119.

Weekly Review of the Market

Limited demand and a downward trend in prices are prevalent in the current wholesale market so far as general commodities are concerned. With building materials, however, the decline has not been so marked during the last week.

Cast-iron pipe dropped $1 per ton in Denver and Douglas fir timbers, $1 in Minneapolis and $2 per M. ft. in Seattle. Long-leaf yellow pine also declined $1 per M. ft. in New York, since last week.

Linseed oil, frequently taken as a barometer of the paint trade, has taken a decidedly upward turn since May 12. The price of raw oil advanced 1c. in Denver, 2c. in Montreal and Minneapolis and 3c. per gal. in Dallas.

There is an appreciable falling off in the demand for lumber. Pine inquiry and demand is quiet. Telegraphic reports to *Engineering News-Record* from the Seattle district, show an active local demand for Douglas fir; Oriental, California and East coast requirements, however, are lighter. Logging camps in the Northwest are closing down because of decreasing log prices, and lumber mill operations are below normal.

Pig-iron inquiries continue to increase in volume. The price of No. 2 foundry iron is firm at $22@$23 per ton, f.o.b. Birmingham. The iron and steel scrap market is also considerably firmer in tone.

There are signs of improvement in the steel market, although minimum quotations on structurals are from 5 to 10c. per 100 lb. under those prevailing two weeks ago at the mills.